Producing Knowledge:

Civil War Bodies and the Development of Scientific Medicine in Nineteenth Century America

(Spine Title: Producing Knowledge: Scientific Medicine in the American Civil War)

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by

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Abstract

The story of medicine during the Civil War has been repeatedly told from a variety of perspectives but it is almost never told in the context of 19th century American medicine. Narratives of the history tell of prewar French medicine and postwar German medicine but they virtually ignore the impact of the war. Yet, with the exception of a few career medical officers, all the medical practitioners of the war were civilian allopathic physicians in 1860 and 1866. In 1862 Union Surgeon General William Hammond issued Circular No. 2, requiring doctors perform autopsies in cases of professional interest as well as collect specimens for the newly formed Army Medical Museum. The circular gave physicians unprecedented access to specimens and nationalized bodies, supporting the institutionalization of scientific medicine.

This study examines the medical department's systematic effort to develop institutional forms of modern science including research in hospitals, mandatory case reports and microscopic analyses for the production and transmission of knowledge. But these activities also revealed the limitations of clinical observation and autopsy and challenged traditional conceptions of disease encouraging the study of diseased structures away from the patient, paving the way for acceptance of the laboratory approach in medical study. Most importantly, this program of scientific medicine introduced a new generation of American physicians to these ideals, transcending the small elite groups that traditionally benefited from foreign travel and urban scientific societies.

This study is supported by a wide range of Civil War case records, contemporary medical journals, personal correspondence and official publications of the Surgeon General's Office, in which the goal to develop scientific medicine is explicit. Analyzing patients, bodies and diseases during the war conferred a new commitment, experience and knowledge giving physicians authority and mastery of the body grounded in science: the epistemological foundation upon which wartime medicine was developed. The record of experience in the war narrative and displayed in the museum challenge the convention that American scientific medicine developed directly as a result of European influences. Medicine during the war offers insight into a largely neglected realm of physician experience and scientific development in the 19th century.

Keywords:

Civil War, nineteenth century, knowledge production, science, medicine, disease, laboratory, investigative medicine, clinical medicine, specialization, theories of disease, cholera, gangrene, erysipelas, dissection, pathology, microscopy, chemistry, therapeutics, bodies, death, military medicine.

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Contents

Introduction:

This is a study about the impact of Civil War medicine on the development of scientific medicine in the United States. In particular, it examines the program of research and investigative medicine during the American Civil War among Union physicians and the diffusion of this knowledge in the later nineteenth century. For four years the war mobilized the country and demanded the participation of people from all sectors of society; when the magnitude of the fighting became clear, it demanded above all, the participation of the medical profession. This account follows the lives of some prominent and not so prominent physicians through the Civil War years and investigates how the medical experience of the war affected the way individual physicians practiced and studied medicine. The aim is to further the understanding of the complex questions that led to the shift in emphasis from pathological anatomy[1] towards experimental physiology, chemistry, microscopy and medical specialization in the later nineteenth-century and the role, if any, played by state and medical mobilization during the Civil War in this transition. To grasp fully the impact of the war on American medicine it is essential to define the conceptual and institutional factors that allowed for the development of medical science in America. In particular, this study explores how medicine was studied, structured (the formal and the informal), taught and learned during the war, and the dissemination of medical knowledge. This dissertation argues that as an educational intervention, the war was as important for some physicians as the Paris Clinical School, if not Germany.

This study maintains that scientific medicine in America developed prior to the ascendency of laboratory medicine and the educational reforms of the late nineteenth and early twentieth century. Nineteenth-century American physicians continually discussed and practiced scientific medicine, which in the three decades prior to the war was

[1] Pathology is the science dealing with the causes of, and changes produced in the body by disease. Pathological anatomy, the attempt to discern the causes of death and nature of disease through the post mortem dissection of the human body, was an important part in elucidating disease from the time of the Renaissance (then commonly called morbid anatomy.) Morbid anatomy developed significantly in the eighteenth century and medical authors began to speak of "pathological anatomy" when "describing clinicians' practice of post mortem dissection." Pathological anatomy led practitioners to think about diseases as if they were distinct entities, often localized in specific organs and tissues. See, Russell Maulitz, "The Pathological Tradition" in (eds) William Bynum and Roy Porter *Companion Volume of the History of Medicine Volume 1*(London: Routledge, 1993) pp. 169-191.

associated with the ideals of the Paris Clinical School.[2] The scientific medicine that was stimulated during the war was very different from the scientific medicine today with its controlled experiments in the clinic and laboratory; but the enthusiastic response to wartime medical challenges and opportunities did allow for the development of some forms of modern scientific medicine, including clinical trials and specialized units within the new hospitals, the collection, dissection and study of specimens and bodies, scientific publications, experimental medicine and practical instruction, professional consultations in the hospitals, and the transmission of this knowledge. To the doctoring physicians, Civil War medicine, whether clinico-pathological investigation, patho-physiology, microscopy, surgery, the chemical analysis of disease processes or therapeutics, was very scientific.[3]

The Civil War is an important place to evaluate the cross-influences of military and civilian medicine. It lasted for four years from 1861-1865, and the demand for physicians was high. *The Medical and Surgical History of the War of the Rebellion* shows that there were almost six hundred thousand cases of mortality and more than a million cases of morbidity. While many physicians chose to serve in the war to support long-held ideological beliefs regarding the Union, it was more than that which compelled duty for some: it was a medical opportunity. Many elite physicians realized that they did not need to travel to Paris or the German countries during these years for unlimited clinical access to patients and unrestricted access to cadavers. Furthermore, the location and pervasiveness of many battle-sites and hospitals made doctoring accessible. Physicians could maintain medical practices in their home towns while simultaneously

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[2] John Harley Warner defines the Paris Clinical School as a "distinctive complex of institutional arrangements, clinical techniques, and teaching practices, modes of organizing knowledge, and structures of medical perception that characterized Paris medicine between 1794 and the mid-nineteenth century." See John Harley Warner, *Against the Spirit of the System: The French Impulse in Nineteenth-Century American Medicine* (Princeton: Princeton University Press, 1998) p. 3. The basic features of the Paris Clinical School included pathological anatomy; clinical correlation, the comparison of numerous cases, active physical exams of patients and diagnosis with instrumentation such as percussion, auscultation, stethoscope; hospital as the locus of medical activity and the use of medical statistics as an analytical tool. Please see foot-note 23-24 for the extensive literature related to Paris medicine.

[3] For more about what constituted scientific medicine for the 19th century practitioner see, George Weisz, *The Medical Mandarins: The French Academy of Medicine in the Nineteenth and Early Twentieth Century* (New York: Oxford, 1995). He demonstrates quite well that the world of science in the 19th century was "heterogeneous and amazingly fluid."See also, John Harley Warner, "Science in Medicine," *Osiris*, 1 (1985):37-58; Michael Sappol, *A Traffic of Dead Bodies: Anatomy and Embodied Social Identity in Nineteenth-Century America.* (Princeton: Princeton University Press, 2002).

serving at a general hospital under the authority of the medical department, and the sources show that physicians highly desired this experience.[4]

This experience was critically important for medicine's larger development because the war years came at a particularly difficult period for orthodox physicians. In antebellum America, scientific medicine was performed on a relatively small scale when bodies could be procured; few physicians even had access to equipment, laboratories, hospitals and patients. Medicine in the Age of Jackson epitomized the anti-intellectual, anti-monopolistic democratic spirit of the times.[5]In making medicine more democratic, restrictions on education were almost abolished and most states repealed their anatomy acts.[6]Antebellum society required little formal training of those practicing as physicians and as a result, the majority were resistant to scientific medicine and specialism, fearing that science was merely a tool of the orthodoxy to support a privileged status.[7]It was very difficult to forge a career in scientific medicine in antebellum America. There was no clinical institution comparable to Paris, and in the 1830s and 1840s a rapid proliferation of for-profit medical schools led to numerous poorly trained practitioners.[8]As Rosemary Stevens argues, "by 1845 there were at least eight states which gave their populations no guidance as to medical standards, and in many others, graduates of chartered medical colleges could ignore the remaining licensing provisions" thus "....the United States

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[4] Silas Weir Mitchell, for example, discusses these benefits for himself and George Morehouse in being able to maintain their practices while also developing their expertise in neurological disorders at Turner's Lane Hospital. See, the Silas Weir Mitchell Papers MSS 2/0241-033, box 11, Library of the College of Physicians, Philadelphia. Some other notable physicians including Samuel Gross, Joseph Leidy, William Thompson, R.B Bontecou, W.W. Keen, Jacob DaCosta (among others) also maintained dual roles see RG 94 (NARA) Personal Papers of Medical Officers and Physicians, Entry 561.

[5] See Harry Watson, *Liberty and Power: The Politics of Jacksonian America* (Hill and Wang: New York, 1990) Chapter 5.

[6] Although anatomy was the cornerstone of medical training in antebellum America, most American Protestants refused to see the body in medical terms. But medical professionals needed cadavers for dissection and thus snatched bodies from their graves, which often led to rage against the medical profession. Beginning in 1831 states began passing anatomy acts which legally allowed medical schools to dissect unclaimed bodies. But most states opposed the passage of these acts and thus only two states had anatomy acts on the eve of the Civil War. See, Michael Sappol, *A Traffic of Dead Bodies: Anatomy and Embodied Social Identity in Nineteenth-Century America.* (Princeton: Princeton University Press,) pp. 4-5.

[7] This difficulty was compounded by the fact that in the 1830s and 1840s most states abandoned licensing regulations thereby abolishing legal regulation of medical practice, and states refused to recognize medical societies. See Rosemary Stevens, *American Medicine and the Public Interest: A History of Specialization* (Berkeley: University of California Press, 1971) p. 27.

[8] As Stevens has pointed out, "over 400 medical schools were founded between 1800-1900." Most university medical schools were outnumbered by the proprietary schools and thus the standards declined in the face of the new competition—(although the elites followed European science closely and the war was thus an important period for developing new, more scientific standards in American medicine.) For more on proprietary medical schools see Stevens, pp. 24-26.

seemed to accept the market as the sole criterion of professional skill."[9]Thus the basic principles of the Parisian Clinical School were well established among the elite but had not yet become diffused among the rank and file in America. The Civil War years provided professional opportunity at a time when medical organization, scientific training and bodies were lacking, and an environment in which competition was not a factor.

The development of medical science had long been a key objective of elite American physicians and almost a thousand physicians travelled to Paris to work with the leaders in French science and medicine prior to the war. Thousands more physicians made their way to Germany after the war, as it became the center of science and medicine in the final third of the century.[10]Although the Civil War years fall squarely between these two periods and thousands of American physicians used the opportunity of the war to develop their knowledge of the body and disease, scholars have not integrated or associated the medical experience of the Civil War with the development of the medical sciences in the nineteenth century. Certain aspects of the war have been well documented including the development of American hospitals;[11]the development of nursing as a result of the war and the role of women during the war;[12]the health of the black soldier during the war;[13]Civil War pharmacy;[14]the institutional history of the war;[15] the war's effect on

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[9] Ibid. P. 27.
[10] See for example, Thomas N. Bonner, "The German Model of Training Physicians in the United States, 1870-1914: How Closely was It followed?" *Bulletin of the History of Medicine* 64 (1990): 18-34.W.F. Bynum, *Science and the Practice of Medicine in the Nineteenth Century* (New York, Cambridge University Press, 1991); George Weisz. *Divide and Conquer: A Comparative History of Medical Specialization* (New York: Oxford University Press, 2006).
[11] Carol C. Green, Chimborazo, *The Confederacy's Largest Hospital* (Knoxville, The University of Tennessee Press, 2004); Charles Rosenberg, *The Rise of America's Hospital System* (Baltimore: Johns Hopkins, 1987); Glenna Schroeder-Lein, *Confederate Hospitals on the Move: Samuel H. Stout and the Army of the Tennessee* (Columbia: University of South Carolina Press, 1994); Frank S. Johns and Ann Page, "Chimborazo Hospital and J.B. McCaw, Surgeon in Chief" *Virginia Monthly Magazine of History and Biography* 62, no. 2 (1954): 190-200.
[12] See for example, Drew Gilpin Faust, "Altars of Sacrifice: Confederate Women and the Narratives of War" *Journal of American History* 76 (1990): 1200-28; Jane E. Schultz, *Women at the Front: Hospital Workers in Civil War America* (Chapel Hill: The University of North Carolina Press, 2004); Anne Austin, *The Woolsey Sisters of New York: A Family's Involvement in the Civil War and a New Profession* (Philadelphia: American Philosophical Society, 1971); Judith Giesberg, *Civil War Sisterhood: The U.S. Sanitary Commission and Women's Politics in Transition* (Boston: Northeastern University Press, 2000).
[13] Clarence L. Mohr, "The Atlanta Campaign and the African American Experience in Civil War Georgia." In *Inside the Confederate Nation: Essays in Honor of Emory M. Thomas*, ed. Lesley J. Gordon and John C. Inscoe (Baton Rouge: Louisiana State University Press, 2005); Joseph T. Glatthar, "The Costliness of Discrimination: Medical Care for Black Troops in the Civil War" in *Inside the Confederate Nation: Essays in Honor of Emory M. Thomas*, ed. Lesley J. Gordon and John C. Inscoe (Baton Rouge: Louisiana State University Press, 2005); Frank Freemon, "The Health of the American Slave Examined by Means of Union Army Medical Statistics." *Journal of the National Medical Association* 77 (1985): 49-52; Margaret Humphreys, *Intensely Human: The Health of the Black Soldier in the American Civil War* (Baltimore: Johns Hopkins, 2008); Paul Steiner, *Disease in the Civil War: Natural Biological Warfare in 1861-1865* (Springfield: Charles Thomas, 1968); Harriet Washington, *Medical Apartheid: A Dark History of Medical Experimentation in Black Americans from Colonial Times to the Present* (New York, Harlem Moon, 2006).

public health;[16]perceptions of death as a result of the war;[17]surgery and disability;[18] however, the war as a stimulus to scientific medicine has not been examined. Indeed some historians have suggested that the war impeded the development of scientific medicine or that Civil War physicians provided disastrous medical care to the soldiers.[19]But this is problematic; there was no clear distinction during the war between the "Civil War physician" and the "American physician" a fact that has been ill considered by historians of the period.

Studies on nineteenth century medicine and Civil War medicine have been remarkably separate. The most striking feature of the literature relating to nineteenth century medicine is not how the war is framed but rather that the role of Civil War medicine in the larger development of American medicine lacks almost any analysis.[20]

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[14] Michael A. Flannery, *Civil War Pharmacy: A history of Drugs, Drug Supply and Provision and Therapeutics for the Union and Confederacy* (New York: Pharmaceutical Products Press, 2004); George Winston Smith, *Medicines for the Union Army: The United States Army Laboratories During the American Civil War* (New York: Pharmaceutical Products Press, 2001)

[15] Louis Duncan, *The Medical Department of the United States Army in the Civil War* (Gaithersburg: Butternut, 1985); Dupree, Hunter A. *Science in the Federal Government: A History of Policies and Activities* (Baltimore: The Johns Hopkins University Press, 1986); Frank R. Freemon, "Lincoln Finds a Surgeon General: William A. Hammond and the Transformation of the Union Army Medical Bureau" *Civil War History* 33 (1987): 5-21; Fielding Garrison, *Notes on the History of Military Medicine* (Washington, DC: Government Printing Office, 1922); Mary Gillett, *The Army Medical Department, 1818-1865* (Washington DC: Government Printing Office, 1987); John Haller, *Farmcoats to Ford: A History of the Military Ambulance, 1790-1925* (Carbondale: Southern Illinois University Press, 1992); Robert Henry, *The Armed Forces Institute of Pathology: Its First Century, 1862-1962* (Washington DC: Government Printing Office, 1964); William Quentin Maxwell, *Lincoln's Fifth Wheel: The political History of the United States Sanitary Commission* (New York: Longmans, 1956).

[16] There is consensus here that the war proved a stimulus for the development of public health in America. See, Gert Brieger, "Sanitary Reform in New York City: Stephen Smith and the Passage of the Metropolitan Health Bill," *Bulletin of the History of Medicine*, 40 (1966): 407-29; John Duffy, *The Sanitarians: A History of American Public Health* (Chicago: The University of Illinois Press, 1990) pp. 110-124; Howard Kramer, "The Effect of the War on the Public Health Movement" *Mississippi Valley Historical Review* 35 (1948):449-62.

[17] Harriet A. Washington, *Medical Apartheid: The Dark History of Medical Experimentation on Black Americans from Colonial Times to the Present* (New York: Harlem Moon, 2006); Franny Nudelman, *Slavery, Violence and the Culture of War: John Brown's Body* (Chapel Hill: The University of North Carolina Press, 2004); Gary Laderman, *The Sacred Remains: American Attitudes Toward Death, 1799-1883* (New Haven: Yale University Press, 1996); Drew Gilpin Faust, *This Republic of Suffering: Death and the American Civil War* (New York: Knopf, 2008); Mark S. Schantz, *Awaiting the Heavenly Country: The Civil War and America's Culture of Death* (Ithaca: Cornell University Press, 2008); James McPherson, *For Cause and Comrades: Why Men Fought in the Civil War* (New York: Oxford University Press, 1997)

[18] Laurann Figg and Jane Farrell-Beck, "Amputation in the Civil War: Physical and Social Dimensions" *Journal of the History of Medicine and Allied Sciences* 48 (Oct. 1993): 454-475; Julian E. Kuz and Bradley P. Bengston, *Orthopaedic Injuries and Treatment During the Civil War* (Kennesaw: Kennesaw Mountain Press, 1996); Gary E. Berman, "Civil War Embalming: A Short History" *Journal of Civil War Medicine* (July-August, 1997): 3-4; Ira Rutkow, *Bleeding Blue and Gray: Civil War Surgery and the Evolution of American Medicine* (New York: Random House, 2005).

[19] Robert Bruce, *The Launching of American Science, 1846-1876* (New York: Alfred A. Knopf, 1987); Gordon Jones, Sanitation in the Civil War." *Civil War Times Illustrated* 5 (November 1866): 12-18; Richard Shryock, "A Medical Perspective on the Civil War" American Quarterly 14 (1962): 161-73.

[20] See for example some standard texts of the period that neglect to analyse/include the role of the Civil War. Erwin Ackernecht, "Anitcontagionism between 1821-1867" *Bulletin of the History of Medicine* 22 (1948): 562-93; James H. Cassedy, *Medicine in America: A Short History* (Baltimore: The Johns Hopkins University Press, 1991); John Haller, *American Medicine in Transition, 1840-1910* (Urbana: University of Illinois Press, 1981); Lester King,

This is partly because the study of the Civil War has developed as a specialty area of study within the history of medicine;[21] as a result most studies on scientific development in the nineteenth century neglect to tackle the war directly. But this is a surprising omission, and more puzzling in light of the fact that most of the elite American physicians at the time doctored in the Civil War. In fact, with the exception of a few career medical officers, all the practitioners of the war were civilian allopathic physicians both in 1860 and 1866. Furthermore, there is a crucially important aspect of the war years that historians have neglected to analyze: the unprecedented government support for research and investigative medicine, and physicians' access to ample bodies to develop medical knowledge. It was an environment that, perhaps somewhat surprisingly, nurtured and encouraged learning, studying, teaching and analyzing all aspects of medicine, which is integral to the story of Civil War medicine.

The period prior to the war, or the "French Period" in American medicine has been well studied,[22] particularly the experiences of the American medical student in

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Transformations in American Medicine: From Benjamin Rush to William Osler (Baltimore: Johns Hopkins University Press, 1991); Charles Rosenberg, *The Cholera Years: The United States in 1832, 1849 and 1866* (Chicago: The University of Chicago Press, 1962); William Rothstein, *American Physicians in the 19th Century: From Sects to Science* (Baltimore: Johns Hopkins, 1985); William Rothstein, *American Medical Schools and the Practice of Medicine: A History* (New York: Oxford University Press, 1987); George Rosen, *A History of Public Health: Expanded Edition* (Baltimore: The Johns Hopkins University Press, 1993); Regina Morantz Sanchez, *Sympathy and Science : Women Physicians in American Medicine* (Chapel Hill: The University of North Carolina Press, 1985); Michael Sappol, *A Traffic of Dead Bodies: Anatomy and Embodied Social Identity in Nineteenth-Century America* (Princeton: Princeton University Press, 2002); Richard Shryock, *American Medical Research* (New York: The Commonwealth Fund, 1947); John Harley Warner, *Against the Spirit of the System* (Baltimore: Johns Hopkins, 1998); John Duffy, *From Humors to Medical Science: A History of American Medicine* (Chicago: University of Illinois Press, 1993) Duffy devotes 15pp to the Civil War but only relies on secondary sources and thus neglects to contribute any new information to our understanding of the war's effect on American medicine.

[21] Most studies consider the war alone and not in the larger context of nineteenth century medicine. See for example, George Adams, *Doctors in Blue: The Medical History of the Union Army in the Civil War* (New York: Henry Schuman, 1952); Alfred Bollet, *Civil War Medicine: Challenges and Triumphs* (Arizona: Galen Press, 2002); Stewart Brooks, *Civil War Medicine* (Springfield: Charles C. Thomas, 1966); H.H. Cunningham, *Doctors in Gray: The Confederate Medical Service* (Baton Rouge: Louisiana State University Press, 1958); Robert E. Denney, *Civil War Medicine: Care and Comfort of the Wounded* (New York: Sterling, 1994); Frank Freemon, *Gangrene and Glory: Medical Care during the American Civil War* (Chicago: The University of Illinois Press, 2001).

[22] Erwin Ackerknect, *Medicine and the Paris Hospital, 1794-1848* (Baltimore, The Johns Hopkins Press, 1967); W.F. Bynum, *Science and the Practice of Medicine in the Nineteenth Century* (New York, Cambridge University Press, 1994); James H. Cassedy, *American Medicine and Statistical Thinking, 1800-1860* (Cambridge: Harvard University Press, 1984); Michel Foucault, *The Birth of the Clinic: The Archaeology of Medical Perception* (New York: Vintage, 1973); Ann La Berge and Caroline Hannaway, "Constructing Paris Medicine," in Hannaway and La Berge, *Reinterpreting Paris Medicine, 1790-1850* (Atlanta: Rodopi, B.V. Amsterdam, Wellcome Series in the History of Medicine, 1998); Toby Gelfand, *Professionalizing Modern Medicine: Paris Surgeons and Medicine Science and Institutions in the 18th Century* (Westport, Conn: Greenwood Press, 1980). He describes the changes in French surgery which had a great impact on how physicians were trained.; Russell C. Maulitz, *Morbid Appearances: The Anatomy of Pathology in the Early Nineteenth Century* (New York: Cambridge University Press, 1987); Stanley Joel Reiser, *Medicine and the Reign of Technology* (Cambridge University Press: Cambridge, 1978) Chapter 2. He discusses the importance of Paris in the development of clinical medicine through the access to medical technology including the stethoscope and the concomitant developments in auscultation, which was also a draw for students.

Paris.[23]Understanding the ideals of French medicine as they were developed during the war years is crucial to the understanding of Civil War medicine, a link or period of development that has not yet been examined. This study begins the analysis with the "French Period" in America, and challenges histories that locate medicine's historical development into three parts: bedside medicine (prior to 1794); hospital medicine (to 1848); laboratory medicine (after 1848), generally located with the shift in migration from France to Germany. These should be seen as overlapping not as a series of paradigm shifts.[24]In particular, this study challenges Erwin Ackerknect's thesis of decline.[25]He suggests that French medicine began to decline in the 1840s because of lack of interest in the medical sciences and the overall failure of Parisians to shift to laboratory style medicine. More recent studies have also suggested this notion of decline is a false construction and that the period is more complex. For example, some pathological anatomists in Paris did use the microscope in their clinical and pathological investigations into the 1850s and beyond.[26]It has also been demonstrated that the clinical tradition remained strong in Paris after 1855.[27]John Harley Warner has similarly challenged

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Richard Shyrock, *The Development of Modern Medicine: An Interpretation of Social and Scientific Factors Involved* (New York: Knopf, 1947); *John E. Lesch, Science and Medicine in France: The Emergence of Experimental Physiology, 1790-1855* (Cambridge: Harvard University Press, 1984); George Weisz, *The Medical Mandarins: The French Academy of Medicine in the Nineteenth and Early Twentieth Centuries* (New York and Oxford: Oxford University Press, 1995); Jaclyn Duffin, "Vitalism and Organicism in the Philosophy of R.T.H. Laennec," *Bulletin of the History of Medicine* 62 (1988): 525-45; John Harley Warner, *Against the Spirit of the System: The French Impulse in Nineteenth-Century American Medicine* (Princeton: Princeton University Press, 1998).

[23] Russel M. Jones, "American Doctors and the Parisian Medical World, 1830-1840," *Bulletin of the History of Medicine* 47 (1973): 40-65; and Russell M. Jones, "American Doctors in Paris, 1820-61: A Statistical Profile," *Journal of the History of Medicine and Allied Science* 25 (1970): 143-57; Dale Smith, "Gerhard's Distinction between Typhoid and Typhus and its Reception in America, 1833-1860." *BHM* (1980): 368-385; John Harley Warner, *Against the Spirit of the System: The French Impulse in Nineteenth-Century American Medicine* (Princeton: Princeton University Press, 1998).; John Harley Warner, "The Selective Transport of Medical Knowledge: Antebellum American Physicians and Parisian Medical Therapeutics", *Bulletin of the History of Medicine* 59 (1985): 213-31

[24] Ann La Berge and Caroline Hannaway, "Constructing Paris Medicine," in Hannaway and La Berge, *Reinterpreting Paris Medicine, 1790-1850* (Atlanta: Rodopi, B.V. Amsterdam, Wellcome Series in the History of Medicine, 1998) p. 46.

[25] Over the past few years Ackernect's thesis has come under much scrutiny even called "overstated and simplistic." See John Harley Warner, "Paradigm Lost or Paradise Declining? American Physicians and the "Dead End" of the Paris Clinical School" in *Reinterpreting Paris Medicine, 1790-1850* (Atlanta: Rodopi, B.V. Amsterdam, Wellcome Series in the History of Medicine, 1998) (eds) Carolina Hannaway and Ann La Berge: pp. 337-383. I would suggest that this "shift" is not as dramatic as has been presented. The incorporation of laboratory medicine happens gradually and unevenly within different cultural contexts. For example, this study suggests the war experience is crucial in supporting new styles of medical investigation.

[26] See, Ann La Berge, 'Dichotomy or Integration? Medical Microscopy and the Paris Clinical Tradition," in in Hannaway and La Berge, *Reinterpreting Paris Medicine, 1790-1850* (Atlanta: Rodopi, B.V. Amsterdam, Wellcome Series in the History of Medicine, 1998): 275-312.

[27] Ann La Berge and Caroline Hannaway, "Constructing Paris Medicine," in Hannaway and La Berge, *Reinterpreting Paris Medicine, 1790-1850* (Atlanta: Rodopi, B.V. Amsterdam, Wellcome Series in the History of Medicine, 1998) pp. 46-47.

Ackerknect's "dead end" thesis[28]by demonstrating that in the 1850s and 1860s American physicians continued to travel to Paris for practical experience at the bedside and dissecting table. Indeed, Warner argues that the migration of American medical men and women continued through the 1850s-1860s and that the "enduring commitments to French ideals" played an important role in "shaping the reception of German medicine and its hallmarks, experimental laboratory science and clinical specialism."[29]But what about the individual physician who knew Paris only at second-hand and who was not part of the elite at the start of the war? And how did "French ideals" come to be practiced, accepted and diffused among the "many" American physicians? What was the actual nature of medicine in 1861 America? Both the elite and the rank and file volunteered to serve in the war. Thousands of physicians sat for the medical examiners, managed unfamiliar diseases, struggled with and mastered diagnoses, cared for thousands of patients, performed countless surgeries, and contributed case histories and specimens to the newly formed Army Medical Museum. How did wartime medicine both shape and contribute to the development of the medical sciences in American medicine?

Historians of nineteenth century American medicine have generally located the development of the medical sciences in the Paris Clinical School and the laboratory based medical sciences which prevailed in the German speaking world after 1860. This shift from the "practicalism" and "clinicism" of Paris to the laboratory-based sciences of Germany has been attributed to the nineteenth-century physicians' continued desire to associate and engage with the "cutting edge" of medical science.[30]John Harley Warner complicates this interpretation by suggesting that while the "shift in destination was real enough" the reasons are more complex than the new superiority of German medical

[28] Ackerknect for example says that by 1848 Paris "hospital medicine had come to its dead end, its momentum spent." See *Medicine at the Paris Hospital*, p. xiii.
[29] Warner, *Against the Spirit of the System*, p. 7.
[30] Thomas Neville Bonner, *Becoming a Physician: Medical Education in Britain, France, Germany and the United States, 1750-1945* (New York: Oxford University Press, 1995); Richard Shyrock, *The Development of Modern Medicine: An Interpretation of the Social and Scientific Factors Involved* (New York, Knopf, 1947) He associates the "intellectual vibrancy" of the medical centre with its "scientific supremacy." Kenneth Ludmerer, *Learning to Heal: The Development of American Medical Education* (New York: Basic Books, 1985) he locates the shift in emphasis from Paris to Germany with the "unchallenged superiority of German Medical Science". Michael Sappol also locates this shift with the new intellectual superiority of Germany and the promise and prestige of laboratory medicine. See, Michael Sappol, *A Traffic of Dead Bodies: Anatomy and Embodied Social Identity in Nineteenth-Century America* (Princeton: Princeton University Press, 2002).

science.[31] He primarily focuses on the experiences of the young elite physicians who travelled to Paris and Vienna as part of their medical education. He explains the empiricism and the anti-rationalism that prevailed among disciples of the Paris Clinical School and demonstrates that "under the banner of empirical truth" they "launched their crusade for reform" transforming "American medical ideas, practices and above all epistemology."[32] He suggests that Paris offered distinct training and unlimited access to bodies; but when the law of 1855 diminished the access that physicians had so valued,[33] they turned to Germany for the same access to patients and bodies.[34] Thus in Warner's interpretation it was less an epistemological departure than the continuation of training and practical experience that was so valued in Paris. There were also those physicians who liked the emphasis on specialism found at the Vienna school along with its focus on microscopy and chemical diagnostic techniques. But, according to Warner this was a "miniscule minority, upon whom the lion's share of historical attention has been lavished" which "set off to Germany for scientific study in the experimental laboratory."[35]

There are a few problems with his interpretation because he has not considered every stage of the nineteenth century physician's development. First, he locates the development of scientific medicine among American physicians solely in Paris and then Germany[36] and completely neglects the war experience. Warner discusses the "shifting

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[31] John Harley Warner, "Paradigm Lost or Paradise Declining? American Physicians and the "Dead End" of the Paris Clinical School" in *Reinterpreting Paris Medicine, 1790-1850* (Atlanta: Rodopi, B.V. Amsterdam, Wellcome Series in the History of Medicine, 1998) (eds) Carolina Hannaway and Ann La Berge: pp. 337-383 See also, *Against the Spirit of the System*, Chapter 9. I would suggest the reasons for the decline are called into question when we think of the war. Very few physicians traveled to Paris or Germany during the war, thus numbers to Paris did decline and travel resumed once again in the post war period. But students wanted specialism, instruction in microscopial and chemical diagnostics. The intellectual frontier changed during these years years-part of this is directly attributed to wartime medicine. Medicine in America is actually the most dynamic that it had ever been during the war. As LaBarge has suggested, "historians of French science and medicine, who have written from a positivistic perspective have, with some exceptions, ignored the period from 1840-1870. This lack attention has reinforced the rhetoric." P. 48 Warner challenges the notion of decline, but by excluding the war, he neglects a very important period of training and development for American physicians.

[32] John Harley Warner, *Against the Spirit of the System*, p. 13.

[33] Warner demonstrates that in 1855 the New Edict in Paris limited private access to patients forcing physicians to follow surgeons on their rounds, which included numerous physicians and students. The private courses (4 or 5 students), largely taught by interns were stopped. John Harley Warner, "Paradigm Lost or Paradise Declining? American Physicians and the "Dead End" of the Paris Clinical School" in *Reinterpreting Paris Medicine, 1790-1850* (Atlanta: Rodopi, B.V. Amsterdam, Wellcome Series in the History of Medicine, 1998) (eds) Carolina Hannaway and Ann La Berge: pp. 337-383.

[34] Although interest in specific courses shifted (e.g. beginning in the 1850s more students took specialty courses)

[35] Warner, p. 305.

[36] He effectively demonstrates the idea of access vs. scientific supremacy but in neglecting the war, a central experience in the lives of many physicians, it is difficult to get a sense of the actual nature of medicine in America.

French and German presence in American medicine" along with the "late nineteenth century battles over how scientific medicine should be defined."[37]But the U.S. Civil War shaped some of these debates, at least in part. For example, some physicians developed microscopy and chemical analysis of disease processes as chief methods of investigation during the war[38]and there were also physicians that developed an experimental mindset during the war. In his examination of American physicians, Warner only refers to the "disciples of Paris medicine" and the "disciples of German medicine." This study in contrast demonstrates there were also proponents or disciples of wartime medicine who combined the theories of both Paris and Germany.

Access at the hospital, bedside and dissection table was also a motivation for the many physicians who clamored for the opportunities of war. But this complicates the overall picture of medical development in the nineteenth century. Instruction at the bedside remained an important teaching method but elite American physicians now instructed more junior American physicians. This created a hierarchy of knowledge and supported the idea of "expert" or specialist leading to the development of new modes of medical study and practice which were important for the reception of clinical specialism and laboratory sciences. Locating this development solely in Vienna is problematic; the evidence suggests a more complex picture in the American case. The intellectual context of medicine changes: physicians valued the idea of becoming producers of medical knowledge and actively sought to be on the same level as elite European physicians. Indeed the importance of their wartime findings, research and publications in the larger context of medicine was often remarked upon. Physicians demonstrated their commitment to scientific medicine by becoming producers of new forms of scientific medical knowledge. They contributed specimens to the Army Medical Museum, published the results of their experiments and findings in the distinctly American *Medical and Surgical History of the War,* the *Army Medical Museum Catalogue* and leading medical journals. A very important finding in this study is that physicians gained a powerful, specifically American medical identity, which was rooted in wartime medicine.

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[37] Ibid. p. 292.

[38] Rather than relying solely on the clinical exam of a patient.

This study is concerned with the elite American physicians who became experts in their respective fields during the war, and continued to shape medicine in the United States after the war. They did not necessarily go to Germany to study with experts in the post war period but rather benefited from the networks of knowledge developed during the war and corresponded with the leaders in their fields as equals. Men like Silas Weir Mitchell, Joseph Woodward, John Shaw Billings, Jacob Da Costa, Howard Culbertson, George Miller Sternberg, John Brinton, all European trained or inspired, were instrumental in shaping medicine in America. They were the new elite in American medicine and did much to develop medical sciences in the post war period. But they were not merely disciples of Paris striving to keep empirically determined clinical truth at the forefront of medical knowledge, nor were they simply proponents of German medicine. There was in fact an American model that developed during the war which emphasized clinical medicine, new kinds of research, transmission of this knowledge and even specialization. For example it has been suggested that Austin Flint was "the most influential physician of his day."[39]Christopher Booth demonstrates that while Flint never studied in Europe he found opportunity in Antebellum America, particularly in Buffalo, Louisville and New Orleans, and as a result was the first to describe the gastric atrophy of pernicious anemia (PA).[40] Flint was the first to associate PA with the stomach, and by describing his pathological and histopathological experiments and observations paved the way for both its management and diagnosis.[41]But Booth neglects to consider Flint's time during the Civil War, which had a profound effect on both his career and the generation of physicians that he taught while a professor of the principles and practice of medicine at Bellevue Medical College in New York (then connected to the hospital), which opened in 1861 in part, to train physicians for the war. Between the years 1862-65 he was an Acting Assistant Surgeon of the U.S Army and a member of the United States Sanitary Commission.[42]While always a prolific writer, Flint published extensively during the war and illustrated his research with numerous Civil War case histories.[43]He had a long career

[39] See Christopher C. Booth, "Clinical Research" in (eds) W.F. Bynum and Roy Porter, *Companion Volume of the History of Medicine Volume 1*(London: Routledge, 1993): pp. 205-229. P. 209.
[40] Ibid.
[41] Ibid.
[42] *New York Times*, March 14, 1886.
[43] Interestingly, his son Austin Flint Jr. joined the faculty at Bellevue in 1861 and was a professor of physiology and microscopic anatomy (this after a year of study in Europe.) Flint Jr. was an eminent physiologist and gained important

in medicine and the war was an integral part of his medical development and informed many of his ideas about medicine and disease. Flint serves as one example, but the war was indeed an important stage in the careers of many American medical men. It was a multilayered period of development and without recovering the impact of this lost generation of American physicians, it is difficult to comprehend how scientific medicine developed in the United States.

Highlighting the new forms of scientific medicine emerging during the American Civil War, this study begins with an examination of the Army Medical Museum and the diffusion of pathological anatomy as a result of the war. A central focus of this study is Circular No. 2. Bonnie Ellen Blustein in her examination of Civil War medicine suggests that the restructured medical department "directed American scientific research energies into physiological and surgical approaches rather than toward the pathological anatomy of the Parisian hospital and German laboratory traditions."[44]In contrast to Blustein, this study argues that the Union Medical Department indeed made efforts to study pathological anatomy through the passage and support of Circular No. 2, which established the Army Medical Museum and mandated the collection and preservation of medical specimens by Union physicians. The museum was to be a vehicle by which to

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practical experience during the war. Indeed, both father and son treated Civil War soldiers and profited from the experience. In 1863 while at Bellevue Austin Flint jr. constructed some important experiments on the blood "employing a new mode of analysis for its nitrogenised constituents" and also some important observations of the function of the liver. Ibid. Both of the Flint's published extensively during, and as a result of, the war. See, Austin Flint (ed.), *Contributions Relating to the Causation and Prevention of Disease, and to Camp Diseases: Together with a Report of Diseases ect. among the Prisoners at Andersonville GA* (New York: Hurd and Houghton, 1867); Austin Flint Sr. , *Practical Treatise of the Diagnosis, Pathology and Treatment of Disease of the Heart* (Philadelphia: Henry Lea, 1870) He refers to the work of Henry Hartshorne, Charles Stille and Jacob DaCosta during the Civil War, in particular their management of the heart diseases of soldiers. Austin Flint Jr. , *A Textbook of Human Physiology* (New York, Appleton, 1888) He describes the importance of anti-scorbutics for proper physiological functioning and he relates the experiences of Civil War soldiers and their improved health after the introduction of onions, beets and various other vegetables. P. 185.; Austin Flint Sr., *Essays on the Conservative Medicine and Kindred Topics* (Philadelphia, Henry C. Lea, 1874) He highlights the importance of ventilation for infectious disease. In particular, he refers to the success in treating gangrene when proper ventilation was enforced. P. 105. Both Flints published a number of articles through the war in the *American Journal of Medical Science, Boston Medical and Surgical Journal, The Medical and Surgical History of the War of the Rebellion, Surgical Memoirs of the War of the Rebellion* and were regular contributors to the Army Medical Museum. For the larger monograph I would like to draw out the impact of these types of educational interventions.

[44] Bonnie Ellen Blustein, "To Increase the Efficiency of the Medical Department: A New Approach to Civil War Medicine" *Civil War History* Vol. XXXIII, No. 1 (1987): 22-39. P. 26. Blustein suggests that the "research sponsored by the Medical Department provided a basis for later development of medical sciences in the United States on a significant scale" (p. 26) but she neglects to demonstrate exactly how knowledge was produced during the war, how individual physicians benefited from the opportunity of the war and if there was an epistemological departure as a result of the war. In fact, she does not return the question of research or the AMM at all in her paper. She does, however, raise a number of interesting points but her brief article neglects to draw out the full significance of the war for either American medicine or the individual physician.

bring about standardization in diagnoses and teaching methods in pathology. The directive to collect specimens was in order for physicians to study disease by correlating the symptoms and signs in the patient with pathological lesions observed postmortem, which was the medical system of the Paris Clinical School. The development of this medical system in the Civil War hospitals allowed physicians to classify diseases by exact symptoms and anatomical changes; this was also important because the manifestation of specific diseases and even the disease itself was seen within specific tissues and organs rather than a product of the whole body. Though localized pathology was understood and accepted by many elite physicians, particularly those who had been to Paris, hospital medicine in America had been slow to develop among the majority of American physicians. Thus Circular No. 2's importance lay in directing medicine towards pathological anatomy and clinio-pathological investigations, allowing the multitude of American physicians that doctored in the war to become familiar with hospital medicine.

The medical department did not, as Blustein suggests, focus the physicians' energies into physiological approaches; it was the physicians themselves who saw the limitations of localized pathology for understanding the function of specific diseases and directed approaches towards physiological and laboratory investigations, moving towards German methodologies. In fact, many elite physicians used the war experience to orient medicine along elite European medical practice. Physicians worked within the framework established by William Hammond, then Surgeon General, and the restructured medical department but it was they who requested material, equipment and opportunities to study specific aspects of medicine, developed ideas about disease and transmitted this knowledge. But it is not the aim of this study to exaggerate the impact of the war: there were continuities between the Paris system and wartime medicine; but the developing epistemological differences between individual physicians are crucial to understanding the context of Civil War medicine and American medicine in the later nineteenth century. Blustein neglects to examine the most important part of wartime medicine, which is the conceptual shift that took place as a result of the wartime medical challenges. If the medical department directed physicians towards physiology at the outset the entire reason for the shift (limitations of localized pathology) are undermined. This study has chosen to focus on gangrene, erysipelas (because they were so unfamiliar and provide an interesting insight into developing ideas about disease) and also cholera, rather than all the diseases that dominated during the war. The objective is to elucidate the reasons that led to demands for new approaches in medical study, which reveal much about the development of scientific medicine in America.

A central theme is access and ownership of military bodies. Little is known about men's bodies during the war, specifically how and what physicians learned from them. This study locates the Civil War body as a crucially important site of medical knowledge. It demonstrates that the government assumed ownership of the individual body during the war for the overall benefit of the national body. The ownership of bodies and specimens for the production of medical knowledge was a central objective of the medical program during the war and this control was exercised in a variety of ways.[45]In his study of the politics of anatomy in nineteenth century America Michael Sappol suggests that, "during the Civil War, the cultural politics of anatomy fell dormant; the war took priority over, disrupted, or restructured other political concerns. Between 1861 and 1865, there were few medical grave robberies, no body snatching scandals, and no debates over anatomy law. There was no need. Bodies were mass produced."[46]In contrast, this study demonstrates that the politics of anatomy did not fall dormant during the war; rather they changed direction. It became less about a general fascination with dissection, grave robberies and restructuring anatomy law than it was about mastering disease—the diseases that ravaged the soldiers.

Medicine became more scientific during and as a result of the war. Sappol suggests that medical research and education began to shift from France to Germany during the prelude to the aftermath of the war. This was a trend among the elite before the war, but during the war more physicians than ever realized the efficacy or potential of laboratory medicine because they literally saw the limitations of clinical medicine through their extensive experience with the body. The war's greatest impact on the politics of anatomy was not merely political, it was the way in which ordinary physicians studied disease: there was now a realization that only with access to bodies, medical

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[45] This study situates this argument within Foucaultian context. In particular, his idea that human interactions are constructed through particular systems of knowledge—in this case the Civil War body. See for example, Michel Foucault, *The Birth of the Clinic: The Archaeology of Medical Perception* (New York: Vintage, 1973).
[46] See, Michael Sappol, *A Traffic of Dead Bodies: Anatomy and Embodied Social Identity in Nineteenth- Century America* (Princeton, Princeton University Press, 2002) p. 238.

equipment and government support that American medicine could develop significantly. Analyzing patients, bodies and diseases during the war conferred a new commitment, experience and knowledge for physicians that translated into an authority and mastery of the body grounded in science. The record of experience in the war narrative and displayed in the museum challenge the convention that American scientific medicine developed directly as a result of European influences. The program of research and investigative medicine, which was sponsored by the Union Medical Department was a vital element in the nineteenth century American physician's anatomical training.

The institutional support for medicine provided by Circular No. 2 was very important in encouraging interest in the basic sciences. It was also a way to ensure that "erroneous medical systems"[47]and competing sects could no longer challenge the dominance of the orthodoxy[48]and its allegiance to medical science.[49]Considering the ascendancy of competing sects in antebellum America, this was hugely significant. In the face of this competition prior to the war, as William Rothstein demonstrates, the orthodoxy had been resilient, "medical societies continued to be formed…and most of the existing ones were being created at an unprecedented rate." This "displayed the prosperity and importance of the profession"[50]but it was not until the war years that the orthodoxy truly achieved professional dominance. This was partly due to the accelerated medical training from which medical professionals benefited but also to the material advantage offered by war service. James Cassedy discusses the "commercial factor" in nineteenth century medicine and suggests that "the pursuit of a medical practice also had

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[47] Regulars tended to view competing sects (and their therapeutic practices as "erroneous.") However, allopathic treatments and therapies were also largely "erroneous." For more on 19th century therapeutic practices please see, Charles Rosenberg, "The Therapeutic Revolution: Medicine, Meaning and Social Change in Nineteenth Century America," in Morris J. Vogel and Charles E. Rosenberg, (eds.) *The Therapeutic Revolution: Essays in the Social History of Medicine* (Philadelphia: University of Pennsylvania Press, 1979); William Rothstein, *American Physicians in the 19th Century: From Sects to Science* (Baltimore: Johns Hopkins, 1985); John Harley Warner, *The Therapeutic Perspective: Medical Practice, Knowledge and Identity in America, 1820-1855* (Cambridge: Harvard University Press, 1986).

[48] The term orthodoxy refers to the regular physicians. The so-called irregular doctors or alternative sects (Thomsonians, Homeopaths and Eclectics) rose in prominence during the early 19th century largely due to the disastrous results of heroic medicine as practiced by the orthodoxy or allopathic physicians (in particular depletive therapies such as bloodletting and calomel). The public also rejected dissections, higher medical fees and the claims to a privileged status adopted by the regulars. See for example, John Duffy, *From Humors to Medical Science: A History of American Medicine* (Chicago: University of Illinois Press, 1993) Chapter 6. William Rothstein, *American Physicians in the 19th Century: From Sects to Science* (Baltimore: Johns Hopkins, 1985)

[49] See, Michael Flannery, "Another House Divided: Union Medical Service and Sectarians during the American Civil War" *Journal of the History of Medicine*, October, 1999: Vol. 54: 489-90. He writes that homeopathists had been almost entirely excluded from the Union Army during the Civil War.

[50] Rothstein, p. 174.

its economic aspects."[51] The physician had to "cope with office records and with the collection of accounts, though he did not do very well at either." He was in "competition for patients with one or more sectarian practitioners, and sometimes made less money than they did."[52] Thus many regular physicians had been forced to supplement their income in a variety of ways which undermined their professional medical status. During the war, however, regular physicians negotiated contracts with the government worth anywhere from $80 to $225 per month (depending on qualifications and position),[53] while treating the national troops thereby providing a professional status that had hitherto eluded many regulars and that was denied to the sectarians.

A number of letters to the Surgeon General's Office illustrate the animosity felt between alternative sects and regular medicine; but perhaps more interestingly, members of alternative sects were willing to sacrifice many of the principles of their practice and defer to the orthodoxy in the hope of being part of the war, thereby sanctioning the authority of regular medicine (at least in the context of military medicine). On June 23, 1862 J.D. Craig a homeopathist from Bristol, Connecticut wrote Hammond aspiring to secure a position in the medical department:

> I am willing to leave my business here and go anywhere you may deem proper, but before doing so I wish to state that I did not graduate at any of the regular colleges. I am a homeopathist- and finished my education in New York where I attended the surgical clinics at the hospitals as I stated in my communication to Dr. Cuyler. I am aware of the repugnance felt by regular physicians to holding professional intercourse with us, but as I shall consider it my duty to practice as far as I am capable according to the requirements of the medical department-the fact of my being a homeopathist may not be an objection. As might be expected from my education, I am not as well posted in regards prescribing remedies according to the regular system as I am homeopathically; still I am not by any means entirely ignorant on the point. On all other subjects relating to the profession, I claim to be well informed, having been in the habit of studying at least two-hours daily. If the objections to my irregular education be not insurmountable, I am at your disposal and will report myself for duty as soon as I hear from you.[54]

On April 28, 1862 W.H. Cook of Cincinnati went above Hammond's head and wrote to Secretary of War, Edwin Stanton pleading to allow competing sects to serve in the army:

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[51] James Cassedy, *Medicine in America: A Short History* (Baltimore: Johns Hopkins University Press, 1991) pp. 58-59. See also, Paul Starr, *The Social Transformation of American Medicine* (New York: Basic Books, 1982) pp. 81-85.
[52] Cassedy, p. 59.
[53] Congressional Globe, 37th Congress, Second Session, 1861-62, 997.
[54] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870, Entry 12, Box 19: J.D. Craig to William Hammond, June 23, 1862.

> I respectfully solicit from your hands an order privileging me to give my gratuitous professional services to soldiers sent to this city for surgical care. I belong to what is known as the botanic medical school of practice. I am aware that this system is not at present employed in the government; and I am not disposed at this time, to make new labors for the administration, nor to raise difficulties for the Medical Bureau, but urging our claims to a share in the army appointments. As the administration undoubtedly feels a great concern for the brave men who are offering their lives for the country, (whose lives are precious in the hearts of millions of relatives at home sustaining business and providing means to support the government and its troops), it is proper to believe that any means which can be used to the advantage or comfort of the soldier, will receive due attention from the president and yourself.[55]

Though his letter had a threatening undertone, he promised to render his "professional services, and as a part of that charity would not interfere with the medical staff in the field."[56]During the war years, sects could no longer rely on the principles of Jacksonian democracy. At a time when the writ *of Habeas Corpus* had been suspended and policing in certain states was commonplace,[57]the individualism that shaped prewar America was severely challenged and civic virtue prized over the antebellum creed of self regarding individualism.[58]George Frederickson suggests that prior to the Civil War America had become a society of "free individuals without institutional restraint"; but, during the war this idealism was challenged. Frederickson proposed that the war both shaped and disciplined the nation; control, organization and structure assumed a new importance in America, which compelled greater reverence for the institution. There was a new commitment to government in which reverence to authority was not only necessary but posited as integral for the preservation of the republic.[59]Although Cook attempted to appeal to Stanton's sense of democratic fairness when he suggested patients had as much

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[55] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870, Entry 12, Box 19: W.H Cook to Edwin Stanton, April 28, 1862.

[56] Ibid.

[57] See James McPherson, *Battle Cry Freedom: The Civil War Era.* (Oxford University Press: New York, 1988) pp. 287-290.

[58] See George M. Frederickson, *The Inner Civil War: Northern Intellectuals and the Crisis of the Union* (New York: Harper and Row, 1965). For more on the idea of the Civil War as reconstituting the US, and the location of the war at the centre of the national narrative see, Drew Gilpin Faust, *This Republic of Suffering: Death and the American Civil War* (Knopf: New York, 2008). She suggests that the "Civil War matters to us today because it ended slavery and helped define meanings of freedom, citizenship and equality. It established a newly centralized nation-state and launched it on a trajectory of economic expansion and world influence." See also, Drew Gilpin Faust, *Mothers of Invention: Women of the Slaveholding South in the American Civil War* (Chapel Hill: University of North Carolina Press, 1996); Melinda Lawson, *Patriot Fires: Forging a New American Nationalism in the Civil War North* (Lawrence, University Press of Kansas, 2002); Anne Rubin, *A Shattered Nation: The Rise and Fall of the Confederacy 1861-1868* (Chapel Hill: University of North Carolina Press, 2005.)

[59] Frederickson, p. 183.

right to choose their physicians as they did their clergyman, Stanton was unmoved. Cook's frustration was evident: "I have twice offered my services to our branch of the Sanitary Commission, which offers have been passed over in silence, I have grounds for believing that one reason for this action was the fear that confusion and contention might arise between myself and other medical gentlemen in attendance."[60] Although he promised his "religion, good upbringing and professionalism" would ensure that no problems ensued, he was unsuccessful in securing a position with the medical department. He went so far as to submit a petition to the war department, signed by fifteen prominent Ohioans, but still did not succeed.[61] It was common for homeopathists to invoke the prized notion of freedom of religion when denigrating the idea of a national practice of medicine. For many homeopathists their exclusion from service challenged the liberalizing ideas that had been validated in the first years of the republic; and the idea that individual independence should be put aside for the benefit of the corporate welfare was often challenged in the name of republican values. In 1862 J.M Howard a homeopathist from Detroit wrote Stanton:

> I transmit the memoirs of the Michigan Homeopathic Institute, a highly respected and useful institution; asking that homeopathic physicians may enjoy the same privileges in the army as allopaths..... They also beg leave to represent to your Department that in the appointment of chaplains there has been no recognition of one denomination to the exclusion of others, and that it would be to the advantage of the whole nation if the surgeons of the Army were selected from the most skillful and efficient practitioners without regard to the school they are attached to. In the opinion of your memorialists, a Republican government cannot with propriety have a national system of religion, or legitimately, a national practice of medicine.[62]

Senator Henry Wilson suggested early in the war that "if it were desirable to bring in medical men of the new school, as we have been asked to do this year by a number of petitioners...the difficulty would be in having these diverse systems of practice in the Army. It would lead to great confusion. I think it better to have it all one or all the other."[63] The allopaths were clearly beneficiaries of this ideological shift and within the federal system were able to exert unprecedented control over the medical affairs of state.

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[60] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870, Entry 12, Box 19: W.H Cook to Edwin Stanton, April 28, 1862.

[61] Ibid.

[62] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870, Entry 12, Box 42: J.M. Howard to Edwin Stanton, Oct. 30, 1862.

[63] Congressional Globe, 37th Congress, Second Session, 1861-62, 997.

Even as the war raged and doctors were overwhelmed with the task of caring for more than a million cases of wounds and disease, the orthodoxy was unrelenting in its refusal to allow alternative sects to contribute to the war effort.[64]

Thus while homeopathists fought to maintain the equal or even superior status they had achieved in relation to the orthodoxy prior to the war, they were effectively excluded from securing medical positions which were sanctioned by the government and Army medical department.[65]As A.M. Woodman of New York pointed out, "there is so much animosity existing between the two schools in this city, physicians with homeopathic diplomas have been refused for examination from the board in this city."[66] Woodman went onto to note that he would be willing to "practice the other school" or "work with a colored regiment if accepted into the service"[67]but the regulars were adamant about maintaining the corps' exclusivity.[68]For the first time in almost 40 years the orthodoxy was free to set the tone of medicine in America, which was at its core scientific. It is not surprising that the orthodoxy took this opportunity to exclude competing sects from serving in the war. William Rothstein has shown that beginning in the late 1840s, orthodox physicians enforced measures which excluded homeopathists from regular medical institutions including medical schools and hospitals.[69] The resolutions of the first meeting of the American Medical Association (formed in part to separate regular physicians from sectarians) in 1847 clearly outlined the objectives of regular medicine:

> Whereas Universal experience has shown that the association of persons engaged in the same pursuit, greatly facilitates the attainment of their common objects; and the

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[64] Some sectarians were able to slip into the ranks but it was rare and when they did they were required to function as regulars. See Flannery, p. 494.
[65] The Wilson Bill (introduced by Free-Soil Republican Henry Wilson), signed into law April 16, 1862, placed central authority for medicine with the Army Medical Department, which was designed to ensure that professional standards were enforced. See, Bonnie Ellen Blustein "To Increase the Efficiency of the Medical Department": A New Approach to Civil War Medicine" *Civil War History*, Vol. XXXIII (1987): pp. 28-29.
[66] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870, Entry 12, Box 109: A.M Woodman to Joseph Barnes, Nov. 23, 1863.
[67] Ibid.
[68] Margaret Humphreys has argued that the black regiments had difficulty maintaining their quota of physicians and that there were often "no candidates available for appointment." She further suggests that hospitals stewards were routinely promoted to pick up the slack since "indifference to formal educational qualifications was probably typical among officers appointing surgeons to black regiments". See, *Intensely Human: The Health of the Black Soldier in the American Civil War* (Johns Hopkins University Press: Baltimore, 2008) chapter 4. She does not mention competing sects and their desire to serve in any capacity during the war, which would be an interesting area to pursue in highlighting both the neglect of the black soldier and the almost complete exclusion of competing sects at any cost.
[69] William G. Rothstein, *American Physicians in the 19th Century: From Sects to Science*. (Johns Hopkins University Press: Baltimore, 1985) pp. 233-235.

medical profession in the United States having a bond of union by which its interests may be protected and its knowledge and usefulness increased. Therefore resolved that it is expedient to establish a National Medical Association for the protection of their interests, for the maintenance of their honor and respectability, for the advancement of their knowledge and to extend their usefulness, and that this convention takes steps to that effect.[70]

It was further determined to adopt a "uniform and elevated standard of Medical requirements for a degree" and that a "uniform code of medical checks should be adopted."[71]It had been almost 15 years since those resolutions were first articulated, yet on the eve of the Civil War regular medicine was still struggling to set the agenda within what John Harley Warner has described as a "medical market-place that was remarkably open,"[72] making it difficult to convince the public of the efficacy of scientific medicine and establish proper standards among the profession.[73]

Individualism in medicine was a powerful force in antebellum America and this extended to the way in which physicians engaged in research and experimental medicine.[74]Those that had access to hospital medicine found few opportunities to engage in research; even if they did it was mostly unstructured and independent. As a result, researchers were unable to develop the confidence of their European counterparts. Part of this was because when physicians were exposed to new findings, for example Gerhard's distinction between typhus and typhoid, there was much confusion about the results of the experiments due to the "lack of opportunity for American practitioners to observe the disease."[75]Physicians did read about Gerhard's findings and were generally aware of the clinico-pathological methods of Paris[76] but this was of little importance until the majority of American physicians could become practically acquainted with localized pathology.

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[70] Isaac Hayes Papers, (APS) B: H334 Box One, "Resolutions for A National Medical Association"; for a meeting May, 1847.
[71] Ibid.
[72] See John Harley Warner, "The Fall and Rise of Professional Mystery" in *The Laboratory Revolution in Medicine* (eds) Andrew Cunningham and Perry Williams (Cambridge: Cambridge University Press, 1992): p. 114. See also Rothstein. He notes that the exclusion of competing sects prior to the war was not uniform throughout the country. Thus the war was important as it provided a cohesive bureaucracy which could systematically enforce the expulsion of competing sects (at least for the duration of the war).
[73] A common feature of many of the unorthodox physicians, along with much of the public, was a strong distrust of allopathic medicine. Thus, the war years were important in enabling the allopaths to advance their agenda (perhaps years before they otherwise may have been able to do so).
[74] If in fact they even did. These pursuits were generally those of the elite.
[75] Dale Smith, "Gerhard's Distinction between Typhoid and Typhus and its Reception in America, 1833-1860." *BHM* (1980): 368-385. p. 379.
[76] Ibid. p. 384.

The requirements of Circular No. 2, the diffusion of hospital medicine and improvements in ability increased medical confidence during the war.

As an example, while the results of Gerhard's and James Jackson's investigations were little understood by the rank and file, Middleton Goldsmith's trials with bromine for the treatment of gangrene and erysipelas, published in 1863, were generally accepted.[77] As will be seen in chapter two, as a result of Goldsmith's successful experiments with bromine and the transmission of this knowledge, the agent became part of the Union supply table and was utilized by a number of physicians who testified to the efficacy of the agent in arresting the progress of both gangrene and erysipelas and also its effectiveness as a prophylactic. Even Confederate surgeons read Goldsmith's articles and essays and adopted bromine as a treatment for hospital gangrene.[78]Physicians could read about "revolutionary" treatments or the results of experiments and test the findings individually.[79]The wartime medical environment thus encouraged experimentation and also provided the opportunity for the practical experience that physicians needed, translating into acceptance of new ways for both the practice and understanding of medicine. For some this meant localized pathology, for others it meant adopting physiological or biological approaches in medical study; and as traditional methodologies were challenged, some physicians came to rely more heavily on investigation and experimentation in medical study.[80]This study is concerned with how physicians learned and how knowledge was produced. A significant finding is that some physicians developed an "experimental" mindset for the management of disease. The idea of experiment was very new—some described their microscopic analyses as experimentalism (which generally only consisted of greater analysis of their practical work), while others constructed more controlled experiments and published the results; the idea of experiment consequently became part of the medical vernacular. The

[77] Or at least debated which was important in developing more depth in American medical study and practice.
[78] Bollet, p. 206.
[79] There was of course a very high mortality from gangrene and erysipelas, so once again I would stress that the new support for investigative medicine is what is most important here. Though bromine did help in reducing the overall mortality of these diseases.
[80] Especially microscopy, chemical analysis of disease processes, which fostered acceptance of Virchow's work first and later bacteriological science.

development of the experimental mindset during the war will be evaluated in its various contexts throughout his study.[81]

The way in which research was conducted was somewhat eclectic—it was not produced in a structured environment such as in a university or hospital-based medical school but as Harry Marks has demonstrated in regard to medicine in the early twentieth century,[82] "medical research flourished in a variety of institutions: research institutes vied with government laboratories, specialty clinics and universities to provide settings suited to the development of medical knowledge."[83]Medical practice during the war was very similar; it saw the origins of institutional research, but there was diversity of research programs and those in them had to work within the framework established by the medical department. But this was still a powerful source of support and individual desires to produce and conduct research were encouraged in a variety of ways: hospitals were equipped with rudimentary research rooms, government supported specialty hospitals were developed along with chemical laboratories, which enabled both individual physicians and the medical department to link clinical work with the government laboratories, particularly the AMM, allowing for some significant developments in American medicine. Most importantly, there was a change in attitude about research, specifically, how knowledge should be produced.

Most physicians did not work in a laboratory independent of what was going on in the hospital—they were not professional researchers and often had countless other duties.

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[81] This study examines medical and human experimentation as part of 19th century medical practice, generally associated with the development of the laboratory in the later 19th century. The goal here is not to look at the ethical context of the experiments but rather how access to bodies shaped medical practice. Patients had little autonomy during the war—ethics is rarely if ever mentioned (certainly not in a coherent statement). When physicians mention the ethics of their experiments, they almost always frame what they are doing as beneficial to the national body.
For the best history of human experimentation and ideas related to "informed consent." See *Useful Bodies: Humans in the Service of Medical Science in the Twentieth Century* (eds.) Jordan Goodman, Anthony McElligott and Lara Marks (The Johns Hopkins University Press, 2003).
[82] And I would say before the formal restructuring of medical schools in America, as recommended by Flexner among others. See, Abraham Flexner, *Medical Education in the United States and Canada: A Report to the Carnegie Foundation for the Advancement of Teaching* (Boston, D.B Updike, 1910) see chapters 4-7. Restructuring would come once again when American medicine developed specialist departments, which offered further professionalism in medical study and practice for the physicians. See, Rosemary Stevens, *American Medicine and the Public Interest: A History of Specialization* (University of California Press, Berkeley) 1971. Chapter 6. I believe that you can trace the beginnings of more structured research and clinical trials during the war.
[83]Harry Marks, *The Progress of Experiment: Science and Therapeutic Reform in the United States, 1900-1990* (Cambridge: Cambridge University Press, 1997) p. 47. For more on the idea of experiment for the production of medical knowledge see John V. Pickstone, *Ways of Knowing: A New History of Science, Technology and Medicine* (The University of Chicago Press, Chicago, 2000).

But clinical medicine and laboratory based medicine[84]were connected during the war (for some more than others) but this reinforced the necessity or potential of incorporating the two.[85] Thousands of physicians were preparing and then sending specimens to the AMM's laboratory so while some of the rank and file may not have worked in a laboratory there was a new consciousness about investigative medicine. For example, some physicians focused on the analysis of tissues or chemical experiments to understand and alter the disease process. One of the most important conceptual revolutions of the war was the development of localized pathology; as Michael Worboys has suggested of medicine in the nineteenth century, "Interest in the chemistry of the body had been stimulated by localized pathology, as it appeared local lesions often produced systematic effects on the whole body by chemical means."[86]Civil War physicians would similarly try to alter the body's chemistry or the progress of the disease through the use of certain drugs. The sheer number of cases allowed doctors to get a sense of the progress of diseases such as gangrene, which if unsuccessfully managed led to pyemia, produced pyemic abscesses throughout the body or cholera, in which physicians often discussed the stages of inflammation and collapse and how best to treat the disease in each stage. While laboratory investigations remained the domain of the few who had microscopic and chemical resources for their investigations, those physicians engaged in laboratory research produced important information about treatments, such as bromine or permanganate of potassa and the medical department's mechanism for transmitting knowledge was remarkably effective. Circulars publishing the results of certain experiments were issued, sometimes in the form of direct orders; some physicians also published the results of their experiments in medical journals, and perhaps most effective, elite physicians were dispatched to hospitals to work with and educate junior physicians. For the first time on a significant scale, medical or therapeutic information generated in absence of the living patient could then be tested in the hospital, where the patients were

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[84] Here I mean studying the body, tissues, organs, bodily emanations in absence of the living patient to produce medical knowledge.

[85] Histology, photomicrography, basic tissue research, physiology etc. were new to many physicians who were shocked at the extent of the work being conducted at the museum. Joseph Jones commented on this when he came to Washington for Henry Wirz's trial and spent a day at the AMM and was amazed at the Union Medical Department's medical accomplishments. See, *Surgical Memoirs of the War of the Rebellion Collected and Published by The United States Sanitary Commission* Vol. II (ed) Frank Hastings Hamilton (New York: Hurd and Houghton, 1871.)

[86] Worboys, p. 33.

closely monitored. The method by which this knowledge was generated was very new, but there was clearly a change in attitude about exactly how to study medicine and thus one of the most important effects of the war on medicine was that the experience demanded or at least encouraged the development of new epistemological standards in American medicine. As argued in chapter three, one important result of this medical development was that there was increasing support for specialization as a result of the war.[87]

Much has been written about the development of medical specialization in the nineteenth-century. Historians agree that by the final third of the century, specialization was perceived as necessary to the continued development of scientific medicine and was thus "scientifically inevitable;"[88]however, accounting for the emergence and spread of medical specialization has led to much more debate among historians. Was it simply that the rapid accumulation of scientific knowledge supported early specialization while also laying a foundation (institutional and intellectual) in which other specialties could develop?[89]Was it due to the development of ontological conceptions of disease? Or was it a combination of factors such as professional organization, institutional support and the intellectual desire to develop medical science (including understanding the new developments that were rapidly transforming medicine overseas)? In examining the emergence of the various specialisms during the war, this study aims to answer some of these questions and contribute to the debate on why and how specialization developed in the final half of the nineteenth-century.

George Rosen suggests that the development of medical specialization was less about the "extensive accumulation of specialized factual knowledge" than "a conception of disease which permits an intensive application to certain circumscribed problem areas."[90]Erwin Ackernect similarly attributes the rise of localized pathology (and this new interest in organs) to the development of clinical specialties; but in his analysis of the Paris Clinical School he outlines specific factors for the emergence of each of the seven

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[87] Before the designation of specialist categories and specialist associations it is important to emphasize that the war was important in supporting the development of specific interests and expertise but there was still limited practice (both during and immediately after the war.)
[88] Stevens, p. 44.
[89] See George Rosen, The *Specialization of Medicine with Particular Reference to Ophthalmology* (New York: Froben, 1944) p. 58.
[90] Rosen, p. 30.

specialties he examines.[91] For example, he illustrates the importance of medical technology (especially in urology)[92] and the emergence of specialty hospitals and institutions in supporting intellectual interest in specific diseases, particularly relating to pediatrics and geriatrics.[93] He also outlines the importance of the unification of medicine and surgery[94] as a precondition to certain specialisms: "The unification of medicine and surgery made dermatology part of a highly developed internal medicine, and venereology became the domain of medical trained surgeons.....the internists-dermatologists unavoidably handled a great deal of syphilis, so dermatology and venereology eventually coalesced into an internal specialty."[95] He further illustrates the importance of the unification of medicine and surgery in the new school of orthopedics which "made it possible to transform orthopedics into a true medicosurgical specialty."[96]

In a more recent study, which explores the origins and development of specialization in the United States, France, Germany and Britain,[97] George Weisz agrees with Ackernecht and Rosen that there was a "fundamental transformation of intellectual perspective" in the development of medical specialties. But rather than attribute this development solely to the emergent pathological conception of disease or the accumulation of knowledge and the use of new technologies, Weisz suggests that it was the unification of medicine with surgery, the emergence of "professional" scientists who were devoted to "advancing medical knowledge through rigorous empirical research" and institutional developments that accounts for the development of medical specialization.[98] William Bynum highlights the emphasis on "circumscribed bodies of medical

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[91] Erwin Ackernect, *Medicine at the Paris Hospital 1794-1848* (Johns Hopkins Press, Baltimore, 1967): pp. 163-180.
[92] Ibid. p. 178.
[93] Ibid.
[94] As George Weisz has similarly demonstrated, the unification of medicine with surgery was important "both as categories of professional practice" and "within institutions of training and research." Only by understanding "medicine as a unified domain did divisions into subfields make very much sense." Prior to this unification "regular" physicians were "divided into three types of professional guilds—medicine, surgery, and pharmacy—each with its separate institutional culture." See, George Weisz, *Divide and Conquer: A Comparative History of Medical Specialization* (New York: Oxford University Press, 2006) p. xix. See also *The Medical Mandarins* p. 4
[95] Ackernect, p. 174.
[96] Ibid. p. 177.
[97] His book is the first comparative history of the subject and considers national differences and similarities over two centuries. He charts the emergence of specialities in France, which provided a model for the US and Germany. This was in contrast to Britain where for much of the 19th century the profession resisted specialties and attempted to keep medicine united. He nicely demonstrates that the development of specialization was part of the new disciplinary communities devoted to research, and here identities were formed. Thus specialization was a part of the wider changes going on in medicine in the 19th and 20th century.
[98] George Weisz, *Divide and Conquer p.* xix, p. 76.

knowledge" including "more focus on a single organ," which resulted from the development of the basic sciences including physiology and pathology.[99] He also outlines the importance of specific institutional factors such as appointments in special branches of medicine in the German universities and the formation of local and national specialist societies.[100] In accounting for the spread of medical specialization he highlights both technological developments in medicine and the professional aspirations of doctors.

In the American context, Rosemary Stevens has highlighted the problems in the professional relationships between general practitioners and specialists particularly the perceived competitive dangers of specialism to the ordinary physician.[101] She suggests that the "well-trained specialist...provided a more insidious form of competition because of his superior scientific skill" posing a serious threat to the rural general practitioner who could "not hope to keep up with scientific improvements in medicine."[102] Stevens argues, however, that specialization was an inevitable development of medical science[103] hence the institutional support in the form of specialist societies, specialized departments in the hospitals, support for specialist practices and recognition from the AMA soon created a structure in which specialization could continue to develop. She also draws attention to specific developments in medical science such as the acceptance of asepsis and antisepsis which proved important preconditions for the development of surgery as a separate and successful specialty.[104] John Harley Warner demonstrates that by the 1850s American physicians and students in Paris felt comfortable studying specialized areas of medicine as long as "they did not declare any intention of becoming a specialist."[105] They were aware of the professional animosity towards specialists in America, but they also knew that there may have been "esteem at home for the kinds of knowledge they were

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[99] William Bynum, *Science and the Practice of Medicine*, p. 191.
[100] Ibid.
[101] Rosemary Stevens, *American Medicine and the Public Interest: A History of Specialization* (University of California Press, Berkeley, 1971). See also Daniel H. Calhoun, *Professional Lives in America: Structure and Aspirations, 1750-1850* (Cambridge: Harvard University Press, 1965); William Rothstein, *American Physicians in the Nineteenth Century: From Sects to Science* (Baltimore: The Johns Hopkins University Press, 1985).
[102] Stevens, p. 44.
[103] Ibid p. 45. The historians discussed here agree that medical specialization in the third quarter of the 19th century was "inevitable." I would suggest to some extent the "inevitability" of specialization has been retrospectively imposed upon the past. In the 19th century, medicine, specialism and especially research was very open and individualistic. What we understand as specialization in medicine today is different than in the 19th century—especially as specialization originated and developed. This study suggests that one of the key issues in explaining the emergence of specialization in medicine is the specific cast of mind. This study will consider pathological specialism to illustrate this point.
[104] Stevens. p. 49.
[105] John Harley Warner, *Against the Spirit of the System*, p. 243.

acquiring in Paris."[106]Indeed elite students who studied in Paris, as Warner has shown, believed specialism could be an acceptable model for medical practice in America. He also suggests that as specialization became more accepted as a professional category, some elite physicians actively sought such knowledge in the postwar period and went to Vienna when the focus shifted to the German universities and teaching hospitals.[107]

Bonnie Ellen Blustein directly relates the development of specialism with medicine to the war. She argues that it was "critically important in setting not only the pace but the pattern of civilian medical science and practice in the last third of the century,"[108]which she attributes to the wartime reorganization of the medical department, hospital organization, the extensive amount of clinical material available for study and the strict examinations of physicians. In her brief paper, however, she neglects to demonstrate exactly how these measures facilitated the rise of medical specialization. Her biography of William Hammond offers greater insight into the emergence of medical specialization through the examination of Hammond's role in the development of neurology. She suggests that the war had a "crucial influence on his career" and "specialism as a scientific mode of practice became intellectually more plausible, and an empirical basis for neurology came within reach."[109] This was in part because Hammond was able to assert himself as an expert and "specialty consultant" and therefore able to make valuable contacts and connections with leading American physicians who could now support his expert status. In contrast to Ackerknecht and Rosen, however, Blustein demonstrates that localized solidistic pathology[110]played a lesser role in the development of neurology than it did in other specialisms since Hammond (and emerging neurologists of the period) tended to focus on the nervous system rather than one particular organ.[111] Indeed, she illustrates that a "non-localized pathology was almost a prerequisite to the

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[106] Ibid.
[107] Ibid. p. 338.
[108] Bonnie Ellen Blustein, "To increase the efficiency of the Medical Department: A New Approach to Civil War Medicine." *Civil War History* 33 (1988) p. 40. Her nineteen-page essay, while ambitious, covers everything from the founding of the USSC to Hammond's court martial and concludes with hospital reform.
[109] Bonnie Ellen Blustein, *Preserve Your Love of Science: Life of William A. Hammond, American Neurologist* (New York: Cambridge University Press, 1991) p.75.
[110]Meaning the study of actual lesions or tumours found within organs and tissues.
[111] Blustein, p. 127.

plausible practice of neurology, since lesions of the nervous system were, even a century ago, recognized as generally irreversible."[112]

By the 1880s, research in medicine was seen as a fundamental necessity to the development of medical science. However, the war lasted for four years. Prior to it, as many historians have pointed out, those physicians advocating medical specialization were viewed as "cultists" or "quacks," specialization was seen as a "hallmark of the charlatan," or specialists were a resented competition. [113]After the war this changed dramatically. A number of specialist associations were formed,[114] more physicians identified themselves as specialists; and by 1870 as William Rothstein has demonstrated: "Specialists had become powerful men in the profession" who "controlled the elite medical societies, dominated the faculties of the medical colleges and the staffs of the hospitals, clinics and dispensaries, and many had powerful and wealthy clients."[115] Between 1850 and 1870 there was a fundamental change to the way medical specialization was viewed. Much has been written about medical specialization, which emerged as a professional category[116]first in the early nineteenth-century in Paris, and then in the German teaching hospitals and universities in the second half of the century. But what was happening in America? Did the war have a role in the development of medical specialization? This dissertation aims to elucidate more fully the forces that led to the development of medical specialization in the later nineteenth century.

Finally, the boundaries of this study should be mentioned. It is concerned with the Union Medical Department and the regular and volunteer Union physicians.[117]The focus is on physicians using the war experience to develop the medical sciences and therefore women and nursing are not considered here. The evidence is drawn from mostly unpublished and published medical case histories, personal physician records, and union medical records, the vast majority of which, particularly the unpublished records, have

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[112] Ibid.

[113] Rosemary Stevens, p. 43; Warner, 292; Bynum p. 192, Weisz, p. 541. I would suggest also that in the face of the competition from competing sects prior to the war, the orthodoxy had to stay unified. As they moved forward as a body during the war, and were less threatened by sects, specialization likely became more plausible.

[114]See William Rothstein, *American Physicians in the Nineteenth Century: From Sects to Science* (Baltimore: The Johns Hopkins University Press, 1985) p. 213; Stevens, p. 46.

[115] Ibid. p.212.

[116] Meaning the way in which specialized study was structured and supported in the teaching hospitals and schools in Paris.

[117] I do plan on tackling the South, which will be published as a companion volume to this study.

not yet been examined by historians. Throughout the dissertation case reports and medical records are quoted extensively to provide the reader with a much broader range of wartime medicine documentation than Civil War studies that rely only on published material. As a result of the sources consulted for this study the physician's voice tends to dominate. Finally, the dissertation examines just the army, not the navy. The very different traditions and medical challenges between the two services are not considered in the present study.[118]

The order of the dissertation is as follows: Chapter One, "Into the Domain of Scientific Medicine: Circular No. 2 and the Army Medical Museum" examines Circular No. 2's directive to collect and dissect bodies and specimens which created a framework in which to develop a sort of research society among the physicians who doctored in the war. The chapter further explores the development of clinico-pathological investigation, dissections in the Civil War, the new medical model that developed in the hospitals, networks of knowledge and the production and transmission of this knowledge to see how scientific medicine was developed during the war. Chapter Two, "Investigative Medicine during the American Civil War: Case study of Erysipelas and Hospital Gangrene" examines the state of medical knowledge in the second half of the nineteenth-century and the dynamism of the war years as they related to the development of theories of disease and investigative medicine. This chapter also explores how the initiatives to develop investigative medicine through the study of these diseases created a model for the integration of laboratory results and clinical observation. Chapter Three, "Research, Bodies and the Development of Medical Specialization," analyzes how the wartime medical model supported the development of specialty study, how unfamiliar diseases and medical challenges fostered an environment that encouraged, even demanded, specialization, and the role of the Civil War hospital and the AMM in supporting the development specialized knowledge. This chapter will attempt to illustrate how and why specialization was developed, shaped and practiced during the war years, specifically how this knowledge was produced and transmitted thereby giving these new modes of practice legitimacy. Chapter Four, "Whose Bodies? Military bodies and the Politics of

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[118] Most of these omissions are simply due to the fact that space is limited here and the inclusion of these materials will not undermine or detract from the argument.

Ownership," discusses the evolving ideas about death during the war, the military's ownership of military bodies and the various ways in which this ownership was contested. The chapter also examines the Civil War body as a site of knowledge and how scientific medicine was developed through the government sanctioned access to the body. Chapter Five, "Post-War Syndrome: Cholera and the Civil War Medical Model in the Post-War Period," will attempt to demonstrate that the medical model developed during the war led to a pattern of recording events, experiences, challenges, research ideas, problems and the transmission of this knowledge. Through an examination of the military's response to the 1866-7 cholera outbreak, this chapter will demonstrate how some of the practices, principles and patterns that were developed to manage disease during the war were adapted in the post war period. These new methodologies became institutionalized and found further support for their development. Finally, some medical professionals found a powerful medical identity through their wartime work and found themselves arbiters of scientific knowledge in the post war period, which will be demonstrated through an examination of both the Toner Lectures designed for the "advancement of medical science," and also of some of the professional relationships that developed during the war out of a mutual desire to develop scientific medicine, which continued to evolve in the post war period.

The dissertation explores how nineteenth-century physicians used the experience of the war to develop scientific medicine. They sought out the experience for the opportunity to develop medical knowledge in particular hospital and dissection experience, but in the process the cases that came into their purview challenged their knowledge in a variety of ways prompting new styles of investigation. The study focuses on the Civil War since it provoked major developments in the lives of the many physicians who doctored in the war and created important opportunities to develop the medical sciences. It is argued that locating the development of scientific medicine in America solely with the Paris Clinical School and the research laboratories generally associated with the German speaking world after 1860 is problematic for a number of reasons. First, there are a series of overlapping paradigms in the nineteenth century and wartime medicine formed an integral educational intervention for American physicians. Second, there were *specific* attempts to develop scientific medicine in America during the war and these must be evaluated in order to understand scientific development *in* America. The atmosphere which physicians created and functioned within elucidates much about what scientific medicine meant during the war and what it would be in the later nineteenth-century. Third, some physicians saw the war experience as a powerful part of their medical identity. Fourth, for many American physicians the war provided an opportunity to orient medicine along the same lines as elite European medical practice, but also to become producers of medical knowledge in unique and unprecedented ways. Finally, investigative medicine and medical practice during the war paved the way for acceptance of German methodologies such as laboratory investigations and medical specialization.

This study will demonstrate that the war encouraged, even demanded, new, more scientific methods in medicine to produce knowledge about the causes, treatment, management and prevention of disease. These included dissection, microscopic analyses of organs and tissues to produce finer distinctions about disease, chemical investigation into disease processes, therapeutic trials and experimentation. The wartime medical environment proved a stimulus for the development of scientific medicine in America and highly important patterns and practices developed during the war were adapted in the post war period. Even though physicians flocked to Germany after the war to continue their education in the medical sciences, the experiences of the war still fundamentally affected not only the way medicine was understood, but also the way in which it was practiced, studied, investigated and framed.

Chapter One:
"Into the Domain of Scientific Medicine: Circular No. 2 and the Army Medical Museum"

Very soon after his appointment, Surgeon General William Hammond saw the great scientific advantage that would accrue to the cause of scientific medicine and surgery by rendering the enormous experience of the war available for future study. Hardly ever in the history of the world has such an opportunity been offered for obtaining specimens illustrative of pathological anatomy.[1]

Thus remarked the physician Harvey E. Brown, Assistant Surgeon U.S.A, in regard to Circular No. 2, which was issued May 21, 1862 by Union Surgeon General William Hammond. For better or worse, war creates opportunity. The destruction of large armies with new weapons forced millions of patients to seek treatment in the newly formed hospitals, which provided an unparalleled medical experience for most physicians. It was here that they gained valuable clinical experience, but the hospital also fostered a dynamic intellectual environment in which new frontiers could be explored. Hammond along with other elite physicians were aware of the opportunity that the war provided. Circular No. 2, which provided for the establishment of the Army Medical Museum, was issued as part of the Union medical department's systematic attempt to develop medical science. It directed medical officers to "diligently collect and forward to the office of the Surgeon General all specimens of morbid anatomy, surgical or medical, which may be regarded as valuable; together with projectiles and foreign bodies removed; and such other matter as may prove of interest in the study of military medicine and surgery."[2] The circular gave physicians unprecedented access to, and ownership of, specimens and bodies on a scale never before experienced in American medicine. Of particular significance, was the circular's role in supporting an epistemological shift

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[1] H.E Brown, *Medical Department of the U.S. Army from 1775-1883* (Washington, DC: Surgeon General's Office, 1873) p. 225.

[2] RG 112 (NARA) "Circulars and Circular Letters of the Surgeon General's Office" Entry 63, Box One p. 23. Circular No. 2 issued, May 21, 1862.

among elite physicians since the chief objectives of the directive encouraged the development of research and scientific medicine. Perhaps most importantly, however, the Union medical department's programmatic attempt to develop medical science brought an unprecedented number of American physicians into the domain of medical science.

As evident through the hundreds of case studies and medical reports submitted to the Surgeon General, Circular No. 2 made a significant impact on the production and development of medical knowledge in American medicine. This chapter evaluates the significance and impact of Circular No. 2 through the examination of case studies and medical reports which were prepared for the Surgeon General; the publications and the dissemination of knowledge; and the resultant networks of knowledge. The circular led to the development of a new research infrastructure for medical study in America, which found its origins in the Army Medical Museum, within the hospitals and through the systematic reporting and mandatory case study required by the circular. This created a written record of experience and encouraged publication; but most significantly, the act of writing cases and becoming familiar with the dynamics of disease had an important benefit for diagnostics, therapeutics, research, knowledge production and professional distinction. Indeed, the objective of the circular was part of a general process of reorientation of scientific medicine in America. This chapter also emphasizes the importance of America's first large national pathological cabinet[3] for medical study in America and the significance of this institutional support for medicine. Clinical material, interesting cases and unfamiliar diseases were similarly important in the development of scientific medicine in America, leading both to emphasis on investigative medicine and resulting in new networks of knowledge—and reliance on these networks. The non-human elements that drove the development of scientific medicine are examined.[4] For

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[3] John Shaw Billings described a pathological museum as a "building or place in which are collected objects of interest"... "a collection of different articles" pertaining to human pathology for the specific purpose of developing medical knowledge. Human bodies had been used for instruction as early as 1306 but began to be systematically collected and arranged in museums or cabinets at the beginning of the seventeenth century (mostly in Europe). By the eighteenth century pathological cabinets were quite common in Europe and were considered essential for medical teaching. See, John Shaw Billings, "On Medical Museums: With Special Reference to the Army Medical Museum at Washington." *Medical News* (September 22, 1888):1-36.

[4] Bruno Latour, for example, favors a complex theoretical model which stresses the role of non-human elements in the process of knowledge formation ("actants"—described as autonomous figures that comprise the material world such as microbes, technologies and ideas). Networks of actants emerge which can both depend on and influence each other, and can shape ideas. See, Bruno Latour, *The Pasteurization of France* (Harvard University Press, Cambridge Mass., 1988). See also, *Science in Action: How to Follow Scientists and Engineers through Society* (Harvard University Press, Cambridge, Mass., 1987).

example, the microorganisms that abounded during the war both drove the project and demanded the development of scientific medicine. What was disease? How could the symptomology of specific diseases best be understood? What did disease entities look like, and what caused them? Networks, ideas, observations and skill had to be marshaled so that an environment in which the troops could be protected from disease could be developed. Microorganisms had the capacity both to shape ideas about disease and redirect them; during the war it was thus imperative that diseases be diagnosed and that medicine be structured in order to ensure the efficacy of medical practice and the safety of the national body.

***William Hammond and the Reform of Military Medicine*:**

During the first year of the conflict, ranking medical officers routinely noted how difficult it was to organize and instill authority among many of the medical practitioners. Soldiers were dying and it was argued that the laissez-faire medical culture among some physicians was contributing to the high rates of mortality and morbidity.[5] In his narrative of service J.T. Calhoun noted that the records of the medical department of many of the regiments were "so imperfect as to be absolutely unworthy…it was rare for any of us to keep a proper set of books."[6] The Union Medical Department was ill prepared when the Confederate batteries fired on Fort Sumter, April 12, 1861 and medical care at the beginning of the war was completely inadequate. The medical department had a difficult time organizing both the volunteer and regular physicians and was inept at managing the hospitals and camps. Diseases such as diarrhea, dysentery, measles, typhoid fever and pneumonia abounded and many new recruits died of disease before they ever reached the battlefield.[7] The medical department was pitifully small in 1860[8]and inadequate to deal with the medical challenges of the war. The head of the Army Medical Department, Thomas Lawson, was over eighty and was generally opposed to spending money on scientific advances. He died shortly after the outbreak of war and was succeeded by the

[5] RG 94 (NARA) J.T. Calhoun "Narrative of Service" in John Brinton's Manuscripts, 1861-1865, Entry 628.
[6] Ibid.
[7] During the summer months of 1861 the sick list routinely averaged close to 30%. See George Worthington Adams, *Doctors in Blue: The Medical History of the Union Army in the Civil War* (Baton Rouge: Louisiana State University Press, 1952) p. 14. The evacuation of troops off the field (lack of ambulance system), preventative medicine and immediate care in the hospitals was reported as "disastrous." Many of the recruits came from rural or isolated areas and were thus vulnerable to myriad of contagious diseases to which they had no immunity.
[8] 1 Surgeon General, 30 surgeons and 83 assistant surgeons; of these 24 surgeons were southern and left the army when the south seceded. Ibid. p. 4.

very conservative Dr. Clement Finley, the next in line in seniority of service, who was according to one observer "utterly ossified and useless."[9] Finley was hugely unpopular, and like Lawson, opposed any type of scientific advance within the medical department.[10] More problematically, he refused to support the use of civilian organizations or women in the hospitals and was regularly accused of hindering the progress of the medical department.[11] Frederick Olmstead lamented: "I believe men are dying daily for the want of a tolerable Surgeon General." [12]These deaths were vividly reported in newspapers and magazines. Americans had only a few years ago read about the similar disastrous medical care of British soldiers during the Crimean War in American newspapers, medical journals and pamphlets and were well aware of the importance of effective medical care, sanitation, proper diet and medical treatment. To help manage the medical problem a group of civilians formed the United States Sanitary Commission.

The Commission determined early on that their objective was to "prevent the evils that England and France could only investigate and deplore. This war ought to be waged in a spirit of the highest intelligence, humanity and tenderness, for the health and comfort, and safety of our brave troops."[13] The Commission proposed a number of reforms including comprehensive medical exams for recruits, the use of women as nurses in the Army hospitals and the hiring of medical cadets.[14] Perhaps most significantly, the Sanitary Commission pressured Secretary of War Edwin Stanton to remove Surgeon General Finley and replace him with someone who would energize the medical department.[15] During the 37th Congress, Bill No. 188[16] was debated, which proposed to "increase the efficiency of the medical department of the Army..." the objective being to get "the right men wherever they may be found, whether in the Army of the volunteer

[9] Quoted in Mary Gillett, *The Army Medical Department, 1818-1865* (Washington DC: Government Printing Office, 1987) p. 154.
[10] According to Adams, he found the purchase of medical books to be an extravagance and refused to spend money on new surgical equipment. p. 4. Finley sealed his own fate when he refused to cooperate with the Sanitary Commission feeling they were merely "mischief-makers" intruding on the medical department's turf.
[11] Gillet, p. 155.
[12] Frederick Olmstead to Henry Whitney Bellows, Sept. 25, 1861 in *The Papers of Frederick Law Olmstead: Defending the Union* (ed) Jane Turner Censor (Baltimore: The Johns Hopkins University Press, 1986) p. 202.
[13] *The Sanitary Commission of the United States Army: A Succinct Narrative of its Works and Purposes* (New York, 1864) p. 5.
[14] Ibid. See also, Adams, pp. 6-7.
[15] Adams pp. 24-27.
[16] The Wilson Bill was named for Free-Soil Republican Henry Wilson and was signed into law April 16, 1862.

force to take these positions."[17] It was argued that "Army surgeons, having their places for life, had less inducement to improvement, and they have had fewer opportunities to improve, than surgeons in civil life......therefore if you want good officers enlarge your circle."[18]After some debate, it was decided that all physicians would be appointed on merit rather than on the seniority system, which opened the door for the appointment of Hammond.[19] He had spent the first few months of the war organizing military hospitals in the northeast where his organizational ability and openness to innovation caught the attention of the Sanitary Commission. Hammond was also one of the few military doctors who understood the important medical contribution that the Sanitary Commission could make. This was partly because he was sympathetic to both military and civilian medical needs. He had entered the Army Medical Service as an assistant surgeon in 1849, and served in various posts over the next ten years; he resigned from the Army in 1860 to take the Chair of Anatomy and Physiology at the University of Maryland, Baltimore; but when the war broke out in 1861 he resigned and re-joined the Army.[20]

Hammond was considered a good candidate because of his long-standing interest in medical and scientific investigation.[21]Prior to the war, he had regularly conducted "laboratory experiments," written numerous "essays and articles (one prize winning) on physiology," routinely collected specimens "for his friends at the Philadelphia Academy of Science and the Smithsonian Institution" and had observed European army hospitals in 1858.[22]He had a forceful personality and was known for getting things done. All this well fitted the objectives of the Commission whose express purpose was to "avoid delay and circumlocution for the purpose of accomplishing efficiency and directness of action."[23]With the support of the United States Sanitary Commission, Hammond was

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[17] Congressional Globe, 37th Congress, Second Session, 1861-62, 995.

[18] Ibid. For more on these debates please see, William Quentin Maxwell, *Lincoln's Fifth Wheel: The Political History of the U.S Sanitary Commission* (New York: Longmans, Green and Co., 1956) pp. 118-129.

[19] Hammond studied medicine in William Van Buren's Office prior to attending the University Medical College of New York. William Van Buren (a former Army Surgeon and professor at University of the City of New York) was a prominent member of the Sanitary Commission and its Executive Committee. He had a personal friendship with Hammond and was instrumental in garnering support for Hammond's appointment.

[20] When he re-entered the Army it was at the rank of lieutenant, the bottom of the promotion list, and he was not given credit for his ten years of service.

[21] Of the eight original members of the Sanitary Commission, three were primarily scientists. See Dupree, *Science in the Federal Government* p. 129

[22] See, William Hammond: Biographical Directory in *The Papers of Frederick Law Olmstead: Defending the Union* (ed) Jane Turner Censor (Baltimore: The Johns Hopkins University Press, 1986) pp. 96-97.

[23] Olmstead to John Strong Newberry, Nov. 16, 1861 *The Papers of Frederick Law Olmstead: Defending the Union* (ed) Jane Turner Censor (Baltimore: The Johns Hopkins University Press, 1986) p. 229.

officially appointed Surgeon General of the United States Army April 14, 1862, and he became the central architect of reform for the Union Medical Department. The appointment was eloquent testimony to the developing support for scientific medicine within the medical department.

Administratively, Hammond contributed fundamentally to the augmentation of scientific medicine with Circular No.2, which filled a gap in America by enabling its scientific base to expand. As Elisha Harris recalled in 1864, "the plan of the Museum originated with Surgeon General Hammond, and may be regarded as one of the fruits of that effort which placed at the head of the Medical Department a thoroughly scientific man as well as accomplished medical officer."[24] It was noted in 1878 by an investigative committee on military affairs that the medical museum was regarded as an "institution universally admitted to be one of the proudest scientific monuments in any age or country."[25]Blustein has suggested that Hammond's restructuring of the medical department, which included the development of a national military hospital system, the hiring of female nurses to meet the demands of war, the introduction of specialty hospitals and a previously unseen dedication to investigative medicine, "would have deep implications for health care in the United States as a whole."[26]Hammond's energetic approach to medicine did indeed revolutionize military medicine as the physician Silas Weir Mitchell observed:

> The organization demanded complete revision; and, in fact as the new surgeon general said, there was not an aspect of his work which was not foggy with embarrassments. Whatever else may be thought or said of Hammond, nothing is more sure to me than that he duly saw and used a great opportunity; that he served his country as few could ever have done; that he created the Army Medical Museum; that he saw the need for and advised the foundation of the Army Medical School; that he pointed out the men who were to direct the Army Medical Museum and the medical library. Until the end of his army career, he was the unfailing friend of scientific study, and created special hospitals for diseases of the heart, lungs and neural maladies.[27]

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[24] Elisha Harris, "Army Medical Museum" *American Medical Times* (Saturday June 25, 1864) 306-7.
[25] RG 112 (NARA) "Report of the Committee on Military Affairs of the Senate of the United States" made to that body Feb. 19, 1878.
[26]Bonnie Ellen Blustein, "To Increase the Efficiency of the Medical Department: A New Approach to Civil War Medicine" *Civil War History* Vol. XXXIII, No. 1 (1987) p. 25. See also Frank Freemon. "Lincoln Finds a Surgeon General: William A. Hammond and the Transformation of the Union Army Medical Bureau" *Civil War History* 33 (1987): 5-21.
[27] Silas Weir Mitchell Papers, Box. 17 Series 7. MSS 2/0241-03. Library of the College of Physicians, Philadelphia, p. 9."Address before the Physicians Club Chicago, Ills. 1902/March/25."

The development and enforcement of these medical reforms during the Civil War enabled the Surgeon General's Office to transcend many of the limitations in medicine that had plagued American physicians prior to the war.[28] Furthermore, institutions which could support the development of American medicine were for the first time supported by the government. Perhaps most important, however, were the physicians themselves, a number of whom viewed the diseases and bodies produced by the war as an unprecedented opportunity to learn valuable lessons that would benefit medicine as a whole.[29] Thus the war years saw two important areas develop which proved a stimulus for scientific medicine, namely: the formal organization of military medicine and the cultivation and development of investigative medicine, first initiated by Circular No.2.

As part of Hammond's reforms, all physicians were subject to strict medical examining boards, which were staffed by professional physicians who valued science as the foundation of the profession. Hammond wanted to ensure that professional standards were enforced within the army medical department and ordered examiners to exclude from practice those deemed unacceptable due to poor medical qualifications.[30] On July 2, 1862, Congress enacted "an act to provide for additional medical officers of the volunteer Service," authorizing medical boards to examine candidates before the appointment of surgeons and assistant surgeons of volunteers.[31] The examining board consisted of a written examination on the basic principles of anatomy, surgery, and the practice of medicine, an oral examination on anatomy, surgery, practice of medicine and pathology, another oral examination on chemistry, physiology, hygiene, toxicology, and materia medica, a clinical, medical and surgical examination at a hospital, an examination on the cadaver and the performance of a surgical operation.[32] The board was permitted to deviate from the above general plan, whenever necessary (usually if a well-known physician applied) "in such manner as it is deemed best to secure the interests of the

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[28] Blustein, p. 24.
[29] RG 112 (NARA) Records of the Office of the Surgeon General, Central Office Correspondence, 1818-1946, Entry 2. Circular Letter issued by Hammond July 27, 1862. Volume 32, p. 25.
[30] As part of Hammond reforms within the medical department, volunteer applicants had to go before a board of medical examiners and faced long and difficult examinations.
[31] RG 112 (NARA) Central Office Issuances and Forms: Circular and Circular Letters of the Surgeon General's Office, 1861-65 Entry 63, "Information for Persons Desirous of Entering the Medical Staff of the Army," Issued by the War Department, Jan. 1860. Box One, p. 5-8.
[32] ibid.

service."[33]Candidates failing one examination were permitted a second examination after two years, but never a third.[34]If candidates were successful they were appointed by the Secretary of War as surgeon or assistant surgeon (which was determined by the examining board).[35]Hammond's insistence that candidates "who passed the best examinations" should be given precedence according to their examination results as reported by the examining boards, proved to be a point of contention between the volunteers and the regulars. As John Brown recalled when Hammond was finally ejected from the service, "Hammond has been the Lucifer who had endeavored to promote discord." [36]Brown was referring to what he perceived as the "interference of the volunteers" in assuming prestigious hospital posts, but Hammond did not mind making enemies. He wanted scientifically minded physicians who would best support his efforts, regardless of seniority of service; but there was much objection from some regulars who felt that perhaps more experienced (i.e. European trained) physicians would benefit unfairly.[37]

Michael Flannery suggests that "when the process got down to the state level, most boards appointed associates and cronies through liberal interpretations of these requirements."[38]This may have been true; however, in the incoming letters to the Surgeon General's Office are hundreds of letters pertaining to the examining boards in which candidates agonized over their results; those that failed often provided excuses and asked to be re-tested; others who had not received their results wrote repeatedly to inquire why; and still others asked for a second chance on their exams.[39]Joseph Woodward, a prominent physician, had his examination delayed and wrote to his wife saying how anxious he was to have his exam completed as he nervously waited in his hotel room.[40]Those who obtained posts and were found to be unqualified were often reported

[33] Reports and invoices: Memorandum: "Information for Persons Desirous of Entering the Medical Staff of the Regular Army," Extract from laws of the United States. NLM, MS C 99
[34] RG 112 (NARA) Central Office Issuances and Forms: Circular and Circular Letters of the Surgeon General's Office, 1861-65, Entry 63, "Information for Persons Desirous of Entering the Medical Staff of the Army," Issued by the War Department, Jan. 1860. Box One, p. 5-8.
[35] Ibid. Volunteers were given the title "acting assistant surgeon."
[36] John LeConte Papers, August 1861-1864, APS B L 493. Brown to LeConte, Jan 22, 1864.
[37] John LeConte Papers, August 1861-1864, APS B L 493. J.B. Brown to John LeConte Dec. 11, 1863 in which they discuss the reforms and the fear of some re. merging volunteers and regulars.
[38] Flannery, "A House Divided," p. 486.
[39] See, RG 112 (NARA) Office of the Surgeon General Letters Received, 1818-1870, Entry 12.
[40] Joseph Woodward's Papers (RG 363), Otis Historical Archives, (NMHM)

to the Surgeon General (though there were of course those that slipped through the cracks) but the evidence is overwhelming that the examining boards' stringent requirements, while a source of anxiety for some physicians, were important in the development of science in the military since they put proficiency in scientific medicine at the forefront of the requirements while simultaneously setting the standards upon which Civil War medicine would develop. Physicians were crucial for the development of American medicine and "the Surgeon-General presumes that every surgeon who has passed the medical examining board is capable of judging the intrinsic value of any pathological specimen."[41]

In reviewing some of the exams, although the medical knowledge is imperfect, (reflecting medicine in 1861), the exams demanded detail, extensive analysis and placed a premium on scientific medicine. Lavington Quick was asked to discuss the symptoms, diagnosis, pathology and treatment of erysipelas, an unfamiliar disease for many Americans, and his essay was surprisingly detailed.[42] Similarly, Roberts Bartholow was asked to write on the varieties, symptoms, causes, diagnosis, pathology and treatment of phrenitis.[43] Joseph Woodward was asked for a detailed essay on the diagnosis, causes, pathology and treatment of gangrene.[44] Not having had the benefit of access that the war would provide, Woodward commented on the difficulty:

In conclusion the writer must express his regret that the subject which has fallen to his but related to a disease of which he has never seen a well marked case, which has compelled him to rely for his account upon the recollections of his reading, a very imperfect substitute he well knows for those personal recollections which he thinks he retains of almost every other surgical affection of importance.[45]

These new requirements for medical practitioners (demands which were unprecedented for most) nevertheless supported the Union Medical Department's programmatic attempt to identify medicine with science. Further, and perhaps most importantly, the boards

[41] John Brinton and George Otis, Letter Book One, Series, 5. Otis Historical Archives RG 15 (NMHM) John H. Brinton to Meylert Dec. 27, 1862.
[42] RG 94 (NARA) Personnel Papers of Medical Officers and Physicians, 'Medical Officers Files," Entry 561, Box 471. Papers of Lavington Quick.
[43] RG 94 (NARA) Personnel Papers of Medical Officers and Physicians, 'Medical Officers Files," Entry 561, Box 38. Papers of Roberts Bartholow.
[44] RG 94 (NARA) Medical Records, 1814-1919, "D" File, Box 15 "Thesis of Joseph Woodward on Hospital Gangrene" dated May 30, 1861.
[45] Ibid.

helped to ensure that the orthodoxy had almost exclusive ownership of medicine through the war years.

Blustein suggests that Hammond's innovations served as a "model of development rooted in prewar medicine" but were able to develop rapidly both during and after the war.[46]One of the most significant and lasting achievements of Hammond's career was the creation of the Army Medical Museum, which enabled him to build, with the help of both young physicians and the very best of American medicine, underdeveloped areas in medicine including research, experimental medicine and the extensive study of diseases. Part of the objective of Hammond and the museum staff was standardization in diagnoses and teaching methods in pathology.[47]From its inception the museum was to be an institution that could support the development of research and experimental medicine. As Woodward noted, "it would meet a want long felt by every medical man in America who has ventured in the domain of original research."[48] Woodward continued:

> It is now the desire of the Surgeon General that so far as the means placed at his disposal will permit, the collection shall be extended so as to embrace all forms of injuries and diseases, so that eventually it shall become a general pathological museum, accessible for study to all medical men who are prosecuting original inquiries. A cabinet of comparable anatomy furnishes the means for useful collateral studies, subordinate to the general purposes of a pathological museum; hence such cabinets are found in connection with most of the great pathological collections of Europe, and one has been commenced at the Army Medical Museum.[49]

In 1861 there was very little institutional support for the development of the medical sciences in America. The Army Medical Museum provided collegial and federal support of investigative medicine and was associated with medical progress. As Billings recalled in 1888:

> The necessities of modern progress in anatomy, physiology and pathology, have led to the creation of medical museums in all parts of the civilized world.....it is certain that the securing and forwarding of [specimens] is a very useful thing to the

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[46] See Bonnie Ellen Blustein, *Preserve Your Love of Science: Life of William A. Hammond American Neurologist* (New York: Cambridge University Press, 1991) p. 10.

[47] See John H. Brinton, "Address to the Members of the Graduating Class of the Army Medical Museum" Otis Historical Archives, RG 124, Box One (NMHM).

[48] Joseph Woodward, "The Medical Staff and the United States Army, and its Scientific Work." An Address delivered to the International Medical Congress at Philadelphia, Sept 6, 1876, p. 8.Woodward Papers, Otis Historical Archives RG 363 (NMHM)

[49] See, Daniel Lamb, *History of the U.S. Army Medical Museum: 1862-1917: Compiled from the Official Records of Dr. D.S. Lamb, Pathologist at the Museum,* (Army Medical Library, Washington, 1917) he quotes Woodward, p. 76.

physician who does it. It tends to keep him in touch with current living thought and work of the profession, to direct his attention to the connection between symptoms and the mechanism of their production, which is often so important in deciding on the remedy to he used, and, above all it gives him an interest in other men's work, and thus broadens his views and increases his pleasure.[50]

Perhaps most importantly, as Billings observed, "the objects of a medical museum are to preserve, to diffuse and to increase knowledge."[51]Thus it is not surprising that Hammond long identified with his role in the development of this institutional support for scientific medicine. One of the clear objectives was to enable American physicians to become, for the first time in a significant way, producers of medical knowledge. As Hammond noted, "soon after my appointment I issued circulars to medical officers inviting them to cooperate in furnishing materials for a medical and surgical history of the rebellion. A large number of memoirs and reports of great interest to medical science, and military surgery especially, have been collected and are now being systematically arranged....The greatest interest is felt in this labor by the medical officers of the army and physicians at large."[52]There was a feeling that while important professional directives would obviously continue to come from across the Atlantic, Americans too could contribute to this dialogue in a significant way. Hammond placed clinical instruments, medical texts and current medical journals such as the "American Journal of the Medical Sciences" and the "Medical News and Library" on the army medical supply table, and he continually encouraged physicians to respond to the opportunity to develop medical knowledge.[53]

Knowledge Production and the Idea of the "Circular":

How was medical knowledge produced during the war? What was of interest? How was the knowledge applied? Finally, how was the knowledge managed? Knowledge was produced in a variety of ways and the form in which it was organized, developed and transmitted was one of the most important facets of Civil War medicine. This knowledge was at the core of the interaction between physicians within the wartime environment and

[50] Billings, "On Medical Museums," 1888 p. 18.
[51] Billings, p. 28.
[52] RG 112 (NARA) "Report of the Surgeon General's Office, November 10, 1862 to Edwin Stanton, Secretary of War. Entry 46, Volume 3 (Jan. 2, 1852-April 25, 1863).
[53] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870. Entry 12, Box 12. Letter to Hammond from Blanchard and Lea April 11, 1863.

was crucial in supporting a new foundation for American medicine.[54] Circular No. 2's directive to collect and dissect bodies and specimens supported a sort of research society among the physicians who doctored in the war. Research during the war differed from traditional research societies in antebellum America, which were generally very small. By contrast, wartime research projects often took the form of large, structured collective investigations of material and knowledge. The war doctors were at the forefront of this type of "collective investigation." Harry Marks has described collective investigations as follows: "those who aspired to transcend the limitations of individual investigators turned to surveying a large number of physicians about their experience"; this type of investigation "enjoyed a brief flurry of interest in England and the United States between the 1860s and the 1890s."[55] Gathering and producing medical knowledge of such scope was a relatively new procedure during the war, and circulars requesting investigations into specific areas proved extremely effective in amassing knowledge. The medical department issued hundreds of circulars requesting that physicians study various subjects for the purpose of constructing knowledge relating to diseases, treatments, diagnoses, hospital construction etc.; within this model the observations and results of the individual physician's experiences and findings could be evaluated in relation to the larger body of knowledge that was being developed. There were numerous case histories that provided an empirical account of soldiers and patients, allowing for a synthesis of the wartime medical environment. Each patient's case history represented a branch of knowledge that could be developed in the wartime environment. There were also physicians who engaged in extensive analyses of bodies, specimens, and even structures such as hospitals and laboratories. Taken together, the role of these experiences created unprecedented medical knowledge for American physicians. It was the Army Medical Museum that provided institutional support for the development of this knowledge.

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[54] This study has relied on a broad range of case files and how the many different and complimentary opinions shaped the discourse and official action taken by the medical department.

[55] Harry Marks, *The Progress of Experiment: Science and Therapeutic Reform in the United States, 1900-1990* (Cambridge: Cambridge University Press, 1997) pp. 43-44. He does not mention the war.
He demonstrates that because collective investigation suggested an equality of observers, the findings were eschewed by critics who suggested that not all were qualified to make "reliable and pertinent" observation. During the war there were fewer critics about collective investigation. It was new and considered a valuable and necessary tool for keeping track of the medical activities of the thousands of doctors who served during the war (though the elite did use the opportunity to train the less experienced physician).

As physicians responded to the mandates of Circular No. 2 the weakness in the training of American physicians was quickly exposed; however, because the circular demanded that physicians deal with the basic principles of disease such as causation and development, this focused study of diseased structures provided a unique opportunity to educate physicians on the basic principles of medicine: understanding, diagnosing, treating, and managing some of the most pervasive microorganisms ever encountered on American soil. It was not just regular and volunteer physicians who benefited from this accelerated training; it was also common practice to contract medical students, who generally only had two years of education in medicine, to act as hospital stewards or medical cadets, all of which expanded the network of American physicians who benefited from the opportunity of the war.[56]Some young physicians were even contracted to work in specialized areas of medicine. For example, Joseph Woodward wrote to Professor Leidy at the University of Pennsylvania and Silas Weir Mitchell at the Jefferson Medical College in the hope of filling a position at the newly formed medical museum to assist with microscopial preparations. He asked for someone with "neatness and mechanical tact" and "some knowledge of microscopial work" though given the limitations in this area of study prior to the war he did concede that "this is not an indispensable."[57]The successful applicant was to be paid ninety dollars per month, receive the title of hospital steward and be granted time to "prosecute his studies" for admission to "civilian medicine" or the "medical corps."[58]There was even the opportunity to partake in "field work"; for example, in January, 1863 John Brinton wrote C.M. McDougall inquiring as to whether he knew of any "young men in New York, of pathological instincts, who would collect for the museum with interest."[59]

In order to meet the demands of field and hospital service, Surgeon General Hammond created the grade of Brigade Surgeon and through the use of acting assistant

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[56] RG 112 (NARA) Records of the Office of the Surgeon General Central Office Correspondence: Letters and Endorsements Sent, 1818-1946, Entry 2. Jos R. Smith to Roberts Bartholow July 12, 1862, Vol. 30 p. 438. Smith noted that Bartholow was authorized to hire medical men from Newton University Hospital; as many as he may have needed. See also, Silas Weir Mitchell Papers, Library of the College of Physicians, Philadelphia Box. 17 Series 7. MSS 2/0241-03 p. 20. "Medical Department during the Civil War: Address before the Physicians Club Chicago, Ills. 1902/March/25."
[57] Joseph Woodward Letterbook, Otis Historical Archives, RG 28 (NMHM). Letter dated November 25, 1864.
[58] Ibid.
[59] John Brinton and George Otis, Letter Book One, Series 5. Otis Historical Archives RG 15 (NMHM) John Brinton to C.M McDougall, January 15, 1863.

surgeons in the city hospitals was able greatly to develop the expertise of many young physicians, including many of note such as Middleton Goldsmith, W.W. Keen, Agnew, Morton, Stille to name a few.[60] The study of specimens and bodies along with the development of the Army Medical Museum led to the institutionalization of pathology, which was very important in laying the foundation for scientific medicine. This was not a new impulse in American medicine. In 1857 The Pathological Society of Philadelphia organized by Samuel Gross, Addinell Hewson and S. Weir Mitchell, was formed with the aim of promoting the study of pathology through the exhibition and study of specimens; however, it was not until the development of the Army Medical Museum that a national cabinet, with its impressive collection and broad range of contributors, could prove a stimulus for medicine. It was common among elite physicians in antebellum America to exclude the rank and file from their societies. But Circular No. 2 transcended the small elite groups that traditionally benefited from urban scientific societies and foreign travel and the "many" were encouraged to participate and contribute for the benefit of science.[61] It was no small event that the government sanctioned and encouraged the production, development and importance of science as part of the medical department's objective.

Physicians, aware of the medical opportunity of the war, anxiously sought medical appointments. This was evident particularly in Philadelphia, the epicenter of American medical science both before and during the war.[62]For example, the prominent physician Jacob DaCosta wrote Hammond: "I beg to offer my services as attending physician by contract for one of the military hospitals in Philadelphia."[63]Benjamin Woodward (who later did fascinating work in his experiments with gangrene) also wrote Hammond: "I am anxious to be in some department of the army while the war lasts."[64] Woodward left a "good practice to come into the service," but welcomed the opportunity

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[60] Silas Weir Mitchell Papers, Library of the College of Physicians, Philadelphia Box. 17 Series 7. MSS 2/0241-03 p. 20. "Address before the Physicians Club Chicago, Ills. 1902/March/25."

[61] In antebellum America it was common for the scientific sessions to be open to visitors; however, only society members could attend the private sessions (which generally discussed goals of the profession, business etc.)

[62] RG 112 (NARA) Records of the Office of the Surgeon General Central Office Correspondence, 1818-1946, Letters and Endorsements Sent, Entry 2. Vol. 30 P. 128. L.A. Edwards to W.L. Wells June 16, 1862. Dr. W. L Wells of Philadelphia hoped to obtain a post of acting assistant surgeon to the new military hospital in West Philadelphia, but was informed that there was no vacancy. He was, however, offered a contract for general service. See also Blustein, p. 34

[63] RG 94 (NARA) Personnel Papers of Medical Officers and Physicians, "Medical Officers Files," Entry 561, Box 144. Papers of J.M. DaCosta: Letter to Hammond dated May 9, 1862.

[64] RG 94 (NARA) Personnel Papers of Medical Officers and Physicians, "Medical Officers Files," Entry 561, Papers of Benjamin Woodward, Box. 657. Letter to Hammond dated August 23, 1862.

to use the war to develop his interests and skills.[65] Similarly, Samuel Gross, Chair of Surgery at the Jefferson Medical College, founder of the Pathological Society of Philadelphia, the Philadelphia Academy of Surgery, and the American Surgical Association, for example, wrote Surgeon General Finley in 1861:

> It will afford me great pleasure to be made chief of one of the military hospitals located in this city. My time will not permit me to visit Washington to apply in person, nor do I deem it necessary to procure credentials, as my character I suppose is well known to that department. The salary is no special object; I want the situation on account of the opportunities it could afford me to study the nature and character of camp diseases in reference to the cooperation of a work on scholarly medicine and surgery.[66] He wrote Finley once again a few months later to remind him "of the kind promise you made me four or five weeks ago to appoint me to one of the government hospitals in this city. I find these institutions are now being opened and it will afford me much pleasure to be placed in charge of one.[67]

Gross, an eminent surgeon, worked in a number of capacities during the war, including training military surgeons to perform amputations and treat gunshot wounds. He also studied the results of surgical operations, camp diseases, and hospital administration and published his observations. Though it was a great demand on his time, he like many others, wanted both the experience and the opportunity to contribute, and his enthusiasm was evident when he received one of his appointments:

> I accept with much pleasure your kind offer to act as a member of the medical board of Philadelphia. Although the position may as you observe involve some sacrifice of time, I shall care nothing for if I can be instrumental in rendering the government some service by providing it with efficient and competent medical officers.[68]

Medical practice during the war years had the important effect of bringing together the best trained American physicians, including those that had obtained post graduate work in Europe, and less experienced American physicians, creating a medical hierarchy and a community of knowledge. For example, early in the war, Hammond

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[65] Ibid. Letter to Barnes March 11, 63 (he discusses here the benefits associated with hospital medicine including his development in the areas of microscopy and pathology).

[66] RG 94 (NARA) Personnel Papers of Medical Officers and Physicians, "Medical Officers Files," Entry 561, Box 235. Samuel Gross to Surgeon General Finley, Dec. 8, 1861. He was paid, however. He initially had two contracts with the Surgeon General's department at $80 each per month (it was highly irregular to have two contracts from different dates.) The second contract was annulled, and he then received the standard contract of $100 per month. See RG 112 (NARA) Records of the Office of the Surgeon General, Central Office Correspondence, 1818-1946, Entry 2, Volume 32, p. 254. Letter to W.S. King from C.H. Alden August 14, 1862.

[67] RG 94 (NARA) Personnel Papers of Medical Officers and Physicians, "Medical Officers Files," Entry 561, Box 235. Gross to Finley, Feb. 4, 1862.

[68] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870, Entry 12, Box 36. Samuel Gross to William Hammond, May 7, 1862.

distributed a number of essays and pamphlets about quinine for the treatment and prevention of malaria, epidemic diseases, pneumonia, amputation and how to treat surgical wounds. These were written by the elite, most of which had studied in Europe, for the benefit of the rank and file who were doctoring during the war.[69]The war then was an important educational intervention for many young physicians. Interestingly with the exception of a few career medical officers, all the practitioners of the war were civilian allopathic physicians in 1860 and 1866. It is well known that some of the more familiar and more renowned physicians sought posts during the war: Joseph Leidy, Henry Bowditch, Alfred Stille, Austin Flint, William Norris, William Thompson and Oliver Wendell Holmes among them; but these years also supported the development of the next generation of elite physicians who helped shape American medicine. It is clear that the war years greatly affected many physicians, particularly through Circular No. 2, which proved instrumental in the professional development of some young physicians. There was a unique opportunity for these young physicians to study with mentors. John Shaw Billings, for example, had just graduated from the Medical College of Ohio in 1860; shortly after the disastrous First Battle of Bull Run, he applied for an army commission in September 1861 and was invited to appear before the examining board for admission to the medical corps of the Union Army. He was appointed a contract surgeon, a position he held during 1861 and 1862 until he was commissioned First Lieutenant in April 1862 and assigned with the task of converting the cavalry barracks at Cliffburne into a hospital, after which he was ordered to Philadelphia where he remained for almost a year.[70]While in Philadelphia he worked at the West Philadelphia hospital with Joseph Leidy, who taught Billings the basic principles of microscopy, a research tool that in 1862 was very new to Billings and which would become instrumental in his professional development.[71] Billings made a number of valuable contacts while in Philadelphia. Silas Weir Mitchell, with whom he would form a life-long friendship noted:

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[69] See for example, *Military Medical and Surgical Essays.* (ed) William A. Hammond (Philadelphia: J.B. Lippincott, 1864) Contributors included William H. Van Buren, Elisha Harris, Austin Flint, Stephen Smith, Valentine Mott and Richard Hodges.

[70] "Medical Officers Who Have Made Contributions of Worth to the Science of Medicine." MS B 281, (NLM) Armed Forces Medical Library Section.

[71] See Charleton B. Chapman, *Order out of Chaos: John Shaw Billings and America's Coming of Age* (The Boston Medical Library: Boston, 1994) pp. 64-65. Billings also suggests that his introduction to Leidy and the introduction to the microscope were "educational factors of major moment in his subsequent career."

> My first acquaintance with John Billings was in the early days of the war—the exact date I cannot give you—but he was for a time attached to Philadelphia Hospitals and either then or previously was the excellent and warm friend of my brother, a medical cadet, Edward Kearsely Mitchell. He had charge of him during a part of his fatal illness and I remember with gratitude his tenderness and his close relation to this brilliant young life. This was the beginning of a life-long friendship and opportunities of helping each other in a great variety of ways.[72]

In the *Armed Forces Medical Library Document Collection* it is noted that by 1874 Billings was "regarded as the foremost authority in public hygiene in America" and had an international reputation for hospital construction.[73]He was also highly regarded for his surgical work; the first American surgeon successfully to perform an excision of an ankle joint (Jan. 6, 1862).[74]His high standing in public health and surgery was an exceptional attainment for someone so young and an examination of his wartime work provides an interesting insight into his development.

In May 1862 Billings reported to the Cliffburne hospital and submitted a report of his work there to the Surgeon General, dated July, 1862. In his report he focused on "histories of cases of special interest" including operations, treatment, specimen analyses and post mortem results.[75]Even at this early stage, Billings was meticulous in his reporting and recommendations. He took charge of 159 cases of gunshot wounds of "varying position, character and gravity" most of these belonging to Rebel soldiers who had been captured at the Battle of Williamsburg. All the wounds, Billings noted, were "suppurating and all the operations performed were necessarily secondary and performed on men too exhausted by a long journey and the pain arising from broken and splintered bones and despondent at being prisoners, all factors to be taken into account in estimating the percentage of mortality."[76]Eighteen cases developed erysipelas, which "responded to local circumscription with pure creosote and nitric acid" and an internal treatment of "quinine with full diet." Billings, was particularly pleased with the results of the case of J.H. Miles of Virginia, who had been struck by a minie ball at the battle of Williamsburg

[72] Silas Weir Mitchell Papers, MSS 2/0241-03 Library of the College of Physicians, Philadelphia Letter to Fielding Garrison Sept. 22, 1913. Mitchell was also instrumental in securing a position for Billings at the University of Pennsylvania as Professor of Hygiene.
[73] Medical Officers who have made contributions of worth to the science of medicine. MS B 281, NLM Armed Forces Medical Library Section. pp. 7-8.
[74] Ibid.
[75] RG 94 (NARA) Records on Diseases and Individual Cases, 1841-1893 File A, Entry 635.
[76] Ibid.

which had "entered the left arm on its outer aspect about 4 inches below the outer third of the clavicle on the same side."[77]Billings noted in the case file that the "humerus was found so extensively split and shattered that amputation of the shoulder was clearly indicated—which operation I immediately performed by the oval method. Not more than two ounces of blood were lost. Five ligatures were used and the flaps closed by suture."[78] Billings prescribed "proper diet" and "simple cold water dressings" and the patient "improved steadily" and within 10 days was "walking perfectly convalescent." This case was later published in the *Medical and Surgical History of the War*.[79]

He also performed, for the first time in his career, a cranial procedure known as trephining.[80] William Rogers, a Private from Company G of the 7th Ohio Volunteers, was wounded at the Battle of Fort Republic by a minie ball, which struck the "frontal bone one inch above the edge of the right orbit."[81]It is recorded in his case file that the patient was "rendered insensible for a few moments after being struck but soon recovered sufficiently to walk off the field"; on admission to the hospital June 15th the patient complained of "but little pain, pupils were normal, pulse regular," however "pulsation of the brain was evident, loose splinters of bone to be felt."[82] Billings thus decided to perform a cranial operation in which the "wound was enlarged and the fragments of bone were removed with the forceps." However, the ball which had "entered the substance of the brain" was not found. The patient developed an infection, continued his decline and almost three weeks after being admitted to the hospital, died. During the post mortem, Billings examined the course of the wound and found the ball "much twisted upon itself lying in a sack of false membrane about one inch beneath the surface of the dura mater—the lateral ventricle of the right side having been opened."[83]He studied the brain quite extensively and, even though he had barely touched a microscope prior to his service in

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[77] Ibid.
[78] Ibid.
[79] See *Medical and Surgical History of the War, Surgical Series*, Volume Three, p. 69 for published case history.
[80] Trephining, which meant making a large hole in the skull in order to reach and remove bullets or bone fragments—there were 200 attempted during the Civil War, with a 43% survival rate. See Alfred Bollet, *Civil War Medicine: Challenges and Triumphs* (Galen Press, Arizona, 2002) p. 168. For Statistics on Cranial Operations see, *The Medical and Surgical History of the War*, Surgical Section, Volume One, p. 193.
[81] RG 94 (NARA) File A, Entry 43 and 89, Cliffburne Hospital "Special Cases: Surgical" reported by John Shaw Billings.
[82] Ibid.
[83] Ibid.

the war, he studied the cyst containing the ball microscopically and noted that it consisted of "interlacing fibres, containing large cells."[84]

In March of 1863 Billings received orders from Surgeon General Hammond to report to Jonathan Letterman, Medical Director of the Army of the Potomac, for duty assignment with the United States Infantry; Second Brigade, Second Division, Fifth Corps.[85] He served in this capacity for nearly two years and was almost always in the field. He noted in his *Narrative of Service* that upon his arrival he immediately began scouting locations for hospitals and engaged in several surgeries including "several amputations among these: two at the shoulder joint also one exsection of the same joint and one of the elbow."[86]During the Battle of Chancellorsville (May 1-3, 1863), shortly after Billings assumed his new post, he established a field hospital at the headquarters occupied by General Hooker (after Hooker had inexplicably retreated from the battle)[87] and found a brick house for the purpose. He noted, "at this place the most extensive shell wounds that I have ever seen came under notice...In two instances the abdominal wall was entirely carried away and from a third I removed the entire head of a three inch shell which had passed into the abdominal cavity and was slightly impacted in the bodies of the lumbar vertebrae."[88]Billings was clearly overwhelmed. He continued:

> In a fourth case the fragment of a shell had passed through the pelvis from one trochanter to the other; while in another the arm had been torn entirely off and the brachial artery was hanging three inches in length and pulsating to within one inch from the end. In two of them it proved difficult to return the protruded mass which in each case was as large as ones fist as the muscles of the abdominal wall were strongly and spasmodically contracted.[89]

Conditions were difficult, however Billings was able successfully to "lift the abdominal walls away from and over the tumor and close the wounds hermetically by means of sutures and collodion."[90]He worked continuously after the Battle of

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[84] Ibid.

[85] RG 94 (NARA) Scientific and Historical Reports: Records of the Record and Pension Office, 1814-1919 File A, Entry 79: Narrative of Service, John Shaw Billings Chancellorsville and Gettysburg.

[86] Ibid.

[87] For the best history of the Civil War see James McPherson, *Battle Cry Freedom: The Civil War Era*. (Oxford University Press: New York, 1988).

[88] RG 94 (NARA) Scientific and Historical Reports: Records of the Record and Pension Office, 1814-1919 File A, Entry 79: Narrative of Service, John Shaw Billings Chancellorsville and Gettysburg.

[89] Ibid.

[90] In 1863 repairing serious intra-abdominal wounds was still very new and surgeons had to rely on European or American textbooks or they invented new procedures for performing these operations. Surgeons had more success

Chancellorsville and was placed in charge of the corps hospital before being assigned to the 7th infantry and medical officer for the USA during the March towards Gettysburg (July 1-3).[91]Once in Gettysburg Billings and his colleague Charles Wagner selected "what we supposed would be the most eligible position for a hospital."[92]Once the battle began Billings "performed a large number of operations of various kinds and worked all night without cessation."[93]When his division moved on July 4, Billings stayed behind in charge of the hospital, which contained about 800 sick and wounded soldiers. He ordered seventeen hospital tents to be pitched and in them he tended to the "most severe cases; about 17 in number." He noted that Medical Inspector John Brinton arrived with the much needed medical supplies and that he was able to also procure clean fresh straw, beef and commissary stores from the town. He praised surgeons Ramsey, Whittingham, Bacon and Prenneman through whose "energy and zeal made the labor of organizing the hospital quickly completed."

It was here that Billings developed his most intensive experience as a surgeon. He noted that there were too many operations to give details of them all (since it was a narrative of service, however, most cases were recorded in his case book), but he did comment on a few remarkable cases including exsections of the shoulder joint. In one case he removed 4 ½ inches of the shaft. He also commented on three cases of hemorrhage, in which he opened the flaps and secured the bleeding vessel. He saw six cases of gunshot wound of the thorax, which were handled by his colleague Assistant Surgeon Howard, who treated these men by hermetically sealing the orifice with collodion, a liquid adhesive. Billings was interested in these cases and thus made a post mortem of one to study further the effect of the wound, remarking on the unusual "abscess of the lung communicating with the pleural cavity which was filled with a sanio purulent fluid."[94]He also commented on five cases of gunshot fracture of the cranium which involved the occipital bone, all proving fatal. He noted that in these cases the onset of death was preceded by a "low muttering form of delirium with occasional paroxysms

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treating these injuries when the intestine was not injured. For more of treating abdominal wounds see, Alfred J. Bollet, *Civil War Medicine: Challenges and Triumphs*, (Galen Press: Arizona, 2002) p. 173.

[91] RG 94 (NARA) Scientific and Historical Reports: Records of the Record and Pension Office, 1814-1919 File A, Entry 79: Narrative of Service, John Shaw Billings Chancellorsville and Gettysburg.

[92] Ibid.

[93] Ibid.

[94] Ibid.

of furious mania."[95]Billings' adeptness as a surgeon and skill in hospital organization did not go unnoticed. The Medical Director of the Army of the Potomac, Thomas McParlin (who had relieved Letterman) commented that Billings had "rendered me the most valuable, varied and constant aid in the discharge of general duties assigned and special ones that emergencies required."[96]After serving for a short time as Medical Inspector of the Army of the Potomac (where he was asked to collect specimens for the Army Medical Museum), he was officially transferred to the AMM where he assisted Woodward in the preparation of specimens, in particular in the microscopial section, which was rapidly developing.[97]It was here that Billings began his long service to medicine and the United States.[98] When he helped design the new hospital and laboratory at Johns Hopkins a few years later, he was instrumental in designing the new curriculum, which focused on areas in which he had become skilled during the war, including record keeping and the development of physiological, microscopial and pathological laboratories. William Bynum has shown that much of the efficacy of the Johns Hopkins program "was its emphasis on learning rather than spoon fed teaching, and on the laboratory, dissecting rooms and ward rather than the lecture room."[99]Stressing the ideal to "learn by doing," was a methodology not unfamiliar to Billings; indeed medical practice during the war required industriousness and the very essence of Circular No. 2 demanded that physicians "learn by doing."

In America, however, industrialism and permanent hospitals had not developed at the same rate as in Europe, and Billings and others did not have these medical opportunities prior to the war, which meant that hospital medicine was slow to develop

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[95] Ibid.
[96] Quoted in Charleton B. Chapman, *Order out of Chaos: John Shaw Billings and America's Coming of Age* (The Boston Medical Library: Boston, 1994) p. 75.
[97] Joseph Woodward Papers, Otis Historical Archives, RG 363 (NMHM)
[98] He prepared a reorganization plan for the Marine Hospital Service, later renamed the Public Health Service which he set on a new course; prepared long reports on Army hospitals and Army hygiene; planned a hospital for the soldiers home in Washington, became active in the affairs of the American public health association; elected member of the National Academy of Sciences; built the Library of the Surgeon General's Office; Billings plans were chosen for the John Hopkins Hospital and Medical School (which began in 1877 and opened in 1889) he was the chief medical advisor to the president of the University, Daniel Coit Gilman. He also stressed the principle "learn by doing", which was part of the Hopkins lure for students. Billings arranged the curriculum for the new school and was instrumental in hiring Welch and Osler. Like his war experience taught, he emphasized the history of medicine, keeping records, and the use of physiological and pathological laboratories which were based on the Army Medical Museum lab. See, Frank Rogers, *Selected Papers of John Shaw Billings: Compiled with a Life of Billings by Frank B. Rogers* (Medical Library Association: Baltimore, 1965) pp. 1-11.
[99] See, William Bynum, *Science and the Practice of Medicine in the Nineteenth Century* (Cambridge: Cambridge University Press, 1994) p. 116.

among the majority of physicians (both due to lack of hospitals and the adherence to traditional methods of practicing medicine in America).[100] Historians have suggested that the basic features of early nineteenth-century hospital medicine including anatomical pathology and specific diagnostic techniques such as percussion, auscultation and palpitation was important in the development of clinical medicine in the early nineteenth century but was also an important feature in the development of modern medicine. Although these practices were well known among some American medical practitioners they were slow to take root and medicine overall remained much as it had been in the first decades of the century. Charles Rosenberg has suggested that "at mid-century every aspect of the relationship between medical knowledge and the hospital was uncertain and subject to future negotiation."[101]The war came along at an important juncture for American medical practitioners, and the general hospitals provide a revealing look into medical treatment and organization for medicine during the war. Most patients arrived from field hospitals and were either in critical conditions or were long term convalescents, which meant that doctors were required to provide extended treatment, keep detailed records and closely monitor and study symptoms, diseases and patients. Physicians in charge of hospitals were directed to make a report of all operations and treatment, keep a register of the sick and wounded, give a full record of the cases including condition of the patients at time of operation (description of wound, mental state and constitutional state), followed by the progress, treatment and result of the cases.[102]

This was a marked shift from the way in which the sick were treated in antebellum America where it was common practice to treat patients at home. During the war, laymen were not able to perform the necessary surgery that was often required after battle and households were no longer equipped to deal with convalescents, making the hospital necessary for a new class of patients and far more physicians.[103] Even those physicians who had studied in Paris clamored for hospital posts, having found upon their

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[100] See Charles Rosenburg, *The Care of Strangers: The Rise of America's Hospital System* (Johns Hopkins University Press: Baltimore, 1987).
[101] Ibid. p. 93.
[102] RG 94 (NARA) Registers of Surgical Operations, 1862-1865 Christian Street General Hospital, Philadelphia, PA. Entry 559, Volume 4, PI-17.
[103] See, for example, Rosemary Stevens, "Sweet Charity": State Aid to Hospitals in Pennsylvania, 1870-1910," *Bulletin of the History of Medicine* 58 (1984): 287-314.

return from France that it was difficult to continue their training due to lack of hospital opportunity. Thus the methods of the Paris Clinical School for many, found their first application in the hospitals of the Civil War, a medical system that was highly compatible with military medicine. In fact, the Civil War hospitals provided an unparalleled medical experience for most physicians. Walt Whitman served as a nurse, visitor and confidant to hospital patients in Washington for more than three years during the war and observed that, "any one of these hospitals is a little city in itself. Take for instance Carver Hospital……. It has more inmates than an ordinary country town. The same with the Lincoln hospital or the Finley hospital or Armory square hospital under Dr. Bliss (one of the best anywhere). It must have nearly a hundred tents, wards, sheds, and structures of one kind and another."[104] Whitman observed that some physicians rose to the challenge of war quite well:

> I meet with first class surgeons in charge of many of the hospitals, and often ward surgeons, medical cadets, and head nurses are fully faithful and competent. Dr. Bliss, head of Armory Square, and Dr. Baxter, head of Campbell, seem to me to try to do their best, and to be excellent in their posts. Dr. Bowen, one of the ward surgeons of Armory, I have known to fight as hard for many a poor fellow's life under his charge as a lioness would fight for her young. I mention such cases because I think they deserve it, on public grounds.[105]

He also noted that the government was "full of anxiety and liberality toward the sick and wounded. The system in operation in the permanent hospitals is good and the money flows without stint….I find no expense spared, and great anxiety manifested in the highest quarters to do well by the national sick."[106] Whitman noted that while incompetence sometimes prevailed in the operation of some of these institutions he believed that they were "generally well conducted."[107] Indeed, the hospitals in America were for the first time controlled by a bureaucracy; not the credentialed administrators that govern the institutions today, but rather the military provided the necessary structure which allowed the institutions to develop and be dominated by the medical profession who in turn used the hospital to fulfill their professional needs. While physicians did need

[104] See, Walt Whitman, *The Wound Dresser: A Series of Letters Written from the Hospitals in Washington During the War of the Rebellion* (Small, Maynard and Company: Boston, 1898) p. 36.
[105] Ibid. p. 18.
[106] Ibid. 43.
[107] Ibid. See also, Clark, Henry G. "Inspection of Military Hospitals." *Boston Medical and Surgical Reporter* 67 (1863): 443-44.

the bodies of soldiers to develop hospital medicine, the hospital and the use of bodies was well justified during the war.

Knowledge formation is dynamic and could be actively manufactured in the context of the war. The diseases that attacked the troops and the institutional support provided by the AMM and the new hospitals created a dynamic medical environment, which led to innovative intellectual and conceptual responses to the challenges. It became an important professional and political aim both to share and learn from this information. The transmission of this knowledge was thus crucial for a number of reasons: it was an attempt to re-organize American medicine so that it was more unified, to orient it to scientific guidelines, and to create a network of knowledge that linked American physicians with each other and European physicians. In conjunction with Circular No. 2, Circular 5 was issued and directed that the research at the museum be published in a *Medical and Surgical History of the Rebellion.*[108] These case histories became the foundation for a new scientific discourse in American medicine. Collecting specimens was one part of the project, leaving a record of this work which validated the physician's work the other. Circular No. 5 requested:

> All medical officers cooperate in this undertaking by forwarding to this office such sanitary, topographical, medical and surgical reports, details of cases, essays and the results of investigations and inquiries as may be of value for this work, which full credit will be given in forthcoming volumes. ...It is scarcely necessary to remind the medical officers of the regular and volunteer services that through the means in question much may be done to advance the science which we all have so much at heart, and to establish landmarks which will serve to guide us in the future.[109]

Hammond pointed out an irresistible collateral benefit to those who chose to participate: "It is therefore confidently expected that no one will neglect this opportunity of advancing the honor of service, the cause of humanity, and his own reputation."[110] John Shaw Billings similarly recalled, "Every medical man in this country should help a little and provide for the perpetuation of his name as that of a physician interested in the

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[108] RG 112 (NARA) Central office Issuance and Forms: Circular and Circular Letters of the Surgeon General's Office, 1861-1865, Entry 63, Circular No. 5 issued June 9, 1862, Washington DC. p. 38.
[109] RG 112 (NARA) Central office Issuance and Forms: Circular and Circular Letters of the Surgeon General's Office, 1861-1865, Entry 63 Circular No. 5 issued June 9, 1862, Washington DC. p. 38.
[110] Ibid.

progress of the profession by sending at least one specimen to [the museum]."[111] Circular No. 5 promised that all contributing medical officers would have their case studies published in the *Museum Catalogue* and the *Medical and Surgical History of the Rebellion* and perhaps national and international medical journals. Physicians sought and savored this potential recognition: it was a chance to be known and make contacts. The process of collecting, analyzing and diagnosing conferred a new commitment, experience, and knowledge of anatomy, physiology, pathology, giving physicians' authority and mastery of the body grounded in science: the epistemological foundation upon which wartime medicine was developed. For many practitioners serving in the war and contributing to the development of scientific medicine through publications led to a new medical identity as producers of medical knowledge. The case studies and the eventual publication of the *Museum Catalogue* and *Medical and Surgical History* structured the collection of specimens, which in many ways became a routine activity through the war. The record of experience which was left behind in the narrative of the war could be accessed by the profession, patients and the public, giving physicians who served during the war a new found status and a measure of social respectability since the work was sanctioned by the medical department and supported by the government. Indeed, Congress appropriated five thousand dollars annually for the museum, which was eventually raised to ten thousand dollars.[112] As a professional body physicians were making important strides toward earning the respect of the public: they were working, even risking their own lives, to save the soldiers still alive and fighting for the preservation of the Union. Pathologists working in the hospital or museum laboratory promised detection of the cause of disease, perhaps improved treatment, and this is how scientific medicine was framed during the war. It was a concept that was important for

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[111] Billings, Medical Museums, p. 31.

[112] Brinton, *Memoirs*, p. 182 see also: Army and Navy News: Congressional Appropriations *American Medical Times* (1864) p.30; "The Army Medical Museum and Library" *Proceedings of the American Medical Association* p. 3. Samuel Gross, Austin Flint and Oliver Wendell Holmes discussed the importance of the museum. After describing the extensive collection of specimens they observed that it was a "great center of attraction for physicians and surgeons from every part of the country"....indeed "from all civilized regions of the earth. During the year 1881, no less than forty thousand persons visited the museum." Physicians around the country were asked to "appeal to the General Government to lend its aid" (they wanted a new fireproof building and 5000.00 more dollars per annum.) It was crucial that the museum and library develop, the authors claimed, "an educated and enlightened medical profession means a great diminution of human suffering....for the needs of the nation." The same arguments were made during the war to compel government support.

the development of the medical sciences: people came to expect a certain efficacy from scientific medicine.

Specimens, Bodies and the Medical Museum:

The Army Medical Museum was constructed at first for the purpose of "illustrating the injuries and diseases that produce death or disability during war, and thus affording materials for precise methods of study or problems regarding the diminution of mortality and alleviation of suffering in armies."[113] The medical portion of the museum was assigned to Joseph Woodward of the Army of the Potomac, the surgical section to John H. Brinton of the volunteers on duty with the Army of the Mississippi.[114] Brinton and Woodward were granted full authority to develop the project and medical officers were "directed to comply with the requests made of them."[115] Prior to the war, Woodward was a professor of theory and practice of medicine at the University of Pennsylvania where he received his medical degree in 1853. His research interests included pathological histology and microscopy and he formed classes for instruction in the use of the microscope and the study of pathology. He was also demonstrator in operative surgery, in charge of the surgical clinic of the university and a prominent member of *The Pathological Society*. He had published extensively on the microscopic aspects of cancerous growths and the anatomical diagnoses of cancers prior to the war and further developed his expertise within the museum.[116] At the outbreak of the war, he offered his services to the Union government and entered the army as an assistant surgeon. The surgical section was assigned to John H. Brinton, the museum's first curator. Brinton received his medical degree in 1852 from Jefferson College in Philadelphia and obtained postgraduate training in Paris and Vienna. He was a professor of the principles and practices of surgery at Jefferson prior to volunteering for services in the Brigade of Volunteer Surgeons in August, 1861.[117] On August 1, 1862 Hammond sent Brinton official orders in which he was directed to "collect and properly arrange in

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[113] RG 94 (NARA) Scientific and Historical Reports: Records of the Record and Pension Office, 1814-1919 File A, Entry 41. George A. Otis, 'Notes on the Contributions of the Army Medical Museum," Feb. 7, 1878.
[114] RG 112 (NARA) Records of the Office of the Surgeon General Central Office Correspondence, 1818-1946. Letters and Endorsements Sent. Entry 2. Hammond to Woodward, May 18, 1862. Special Orders No. 98, May 3, 1862 assigned Woodward and Brinton to "special duty" in the office of the Surgeon General.
[115] RG 112 (NARA) Records of the Office of the Surgeon General Central Office Correspondence, 1818-1946. Entry 2. Letters and Endorsements Sent. Circular Letter June 9, 1862. Volume 30, p. 124.
[116] Personal Papers of Joseph Woodward, Otis Historical Archives RG 363 (NMHM).
[117] John H. Brinton Manuscript Collection, Otis Historical Archives, RG 124, Box One (NMHM).

the military museum all specimens of morbid anatomy, both medical and surgical, which have accumulated since the commencement of the rebellion in the various hospitals, or which may have been retained by any of the medical officers of the Army."[118] Hammond also dispatched a number of medical officers[119] to various hospitals to obtain from the surgeon in charge "all specimens that had accumulated since the establishment of that hospital."[120] They were also charged with going to the battlefield, usually following a large conflict, where they would both elucidate the overall importance of the project and engage in a series of demonstrations on how to prepare specimens, even digging out trenches where corpses had been buried; however, because evacuation was often slow, that was rare and bodies were in any event usually quite accessible. In his memoirs, Brinton recalled the method under which specimens were collected and prepared:

> First of all the man had to be shot, or injured, to be taken to the hospital for examination, and in a case for operation, to be operated upon. If all this were taking place in a city hospital, or a permanent general hospital, the bones of a part would be removed would be partially cleaned and then with a wooden tag and carved number attached, would be packed away in a keg, containing alcohol, whiskey, or sometimes salt and water. Then when a sufficient number of specimens had accumulated, the keg would be sent to Washington and turned over to the Army Museum, where the preparations of the specimens would be finished, so that they could take their place upon the shelves.[121]

Once procured, specimens were turned over to the depot quartermaster for transport to Washington under the provisions of General Order No. 27. A representative of Adams Express Company was then contacted (by 1864 the government had a financial arrangement with the company)[122] to deliver the specimens to the museum where they were prepared, verified, recorded and studied when the corresponding case history arrived days later.[123] The project began slowly, as Brinton remarked, with initially "just three dried varnished specimens placed on the little shelf—it was a bit of a joke at first—

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[118] Outgoing correspondence, Otis Historical Archives RG 21 John H. Brinton Sept. 25, 1862 Letterbook One, series 5.(NMHM)

[119] He sent orders to Surgeon Lavington Quick, U.S.V Baltimore; Acting Assistant Surgeon Edward Hartshorne, Philadelphia; Acting Assistant Surgeon George Shrady, New York; Surgeon Middleton Goldsmith, Louisville; Surgeon F.J. Carpenter, Cincinnati; Assistant Surgeon F.L. Town, Nashville; Surgeon John Hodgen, St. Louis and Surgeon H.S. Hewitt, Army of the Mississippi. Those selected were respected surgeons with interest and experience in pathological studies. See, Daniel Lamb, *History of the U.S. Army Medical Museum: 1862-1917: Compiled from the Official Records of Dr. D.S. Lamb, Pathologist at the Museum,* (Army Medical Library, Washington, 1917) p. 13.

[120] Ibid.

[121] Brinton, *Memoirs*, p. 186.

[122] Outgoing correspondence, Otis Historical Archives RG 21. Woodward to Barnes, June 21, 1864.(NMHM)

[123] Outgoing correspondence, Otis Historical Archives RG 21 John H. Brinton Letterbook One, series 5. Brinton to R.G. Wood Oct. 13,1862. (NMHM) To be discussed at length in chapter 4.

no idea that it would become the magnificent military museum, which I believe influences and will influence to no slight degree the future of American military surgery."[124] At first the Army Medical Museum was to be limited to military medical subjects and as Brinton noted, the influence of the medical museum on the army surgeon was first confined to collecting and listing; however, it soon evolved into classification, description and analysis.[125] General Order No. 116 issued May 22, 1863, set up the museum and working laboratory, where the specimens would be dissected and studied.[126] Hammond requested medical specimens of disease illustrating morbid processes of every kind, particularly those which would effectively demonstrate the morbid condition including diseased organs, a series of specimens illustrating disease of the brain, nervous system, heart, tubercles of the lungs, cancers and tumors of internal organs, specimens illustrating enteric fever and chronic diarrhea, parasites, concretions and calculi, including microscopial preparations, which were to be mounted on slips of glass. Healthy specimens taken after autopsy for comparative purposes were also requested.[127] For the surgical section, specimens illustrative of surgical injuries and affections including fractures, excised portion of bone, diseased bones and joints, the structure of stumps, wounds and vessels from nerves, and any extraordinary injuries were requested.[128] Joseph Barnes who succeeded Hammond as Surgeon General in late 1863 expanded the project as one of his first official orders.[129] Under his jurisdiction the work of collecting material for the Army Medical Museum was pushed vigorously (General Order No. 306 confirmed that medical officers had command of general hospitals, in which they were ordered to procure all specimens).[130] In 1864, Barnes broadened the directives of the

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[124] Ibid.
[125] See John H. Brinton, "Address to the Members of the Graduating Class of the Army Medical Museum." John H. Brinton Manuscript Collection, Otis Historical Archives, RG 124, Box One (NMHM).
[126] Ibid.
[127] Report by Brinton to SGO, 1863. Otis Historical Archives, RG 6 Curatorial Records: Circulars and Report, Box One (NMHM)
[128] Ibid.
[129] RG 94 (NARA) Personal Papers of Medical Officers and Physicians, Entry 561, Box 34. Barnes replaced Joseph R. Smith, who had been standing in for Hammond, on Sept. 3, 1863. For more on Hammond's removal as Surgeon General please see Bonnie Ellen Blustein, *Preserve Your Love of Science: Life of William A. Hammond, American Neurologist* (New York: Cambridge University Press, 1991); Frank R. Freemon, "Lincoln Finds a Surgeon General: William A. Hammond and the Transformation of the Union Army Medical Bureau" *Civil War History* 33 (1987): 5-21; Mary Gillett, *The Army Medical Department, 1818-1865* (Washington DC: Government Printing Office, 1987).
[130] "Medical Officers who have Made Contributions of Worth to Science of Medicine." Armed Forces Medical Library Document Section, NLM, MS B 281. Barnes took over as acting assistant surgeon general Sept. 1863, and was appointed Surgeon General August 1864.

collection to include human anatomy, physiology, pathology, somatological anthropology, instruments and apparatus, and illustrations of methods of teaching connected with special departments of practical medicine.[131]

Physicians then were required to diagnose, monitor, and treat conditions, record patient progress and perform autopsies when necessary, culminating in the delivery of the specimen to the museum along with a case report. This accelerated training also benefited the so-called elite physicians, as illustrated in the case of physician Henry Hartshorne.[132] Hartshorne was a prominent Philadelphia physician, who received his A.B. from Haverford College in the early 1840s and his M.D. from the University of Pennsylvania in 1845. His thesis entitled "Water and Hydropathy" was well received by his peers.[133]He served as resident physician at Pennsylvania Hospital from 1846-1848, while simultaneously operating a medical practice. In 1853-54, he became a professor of the Institutes of Medicine at the Philadelphia College of Medicine, and the following year he worked in Columbia, Pennsylvania during a cholera outbreak there. In 1855 he became a consulting physician and lecturer in clinical medicine at the Philadelphia Hospital, and from 1857-1858 he lectured on natural history at the Franklin Institute. In 1859 he became Professor of the Theory and Practice of Medicine at Pennsylvania College in Gettysburg, a post he held until the war broke out in 1861.[134]During the Civil War he worked at two government hospitals in Philadelphia and volunteered his services after the Battle of Gettysburg (July 1-3, 1863). Like all attending physicians he was required to submit all of his case histories: "According to the instructions, I submit the following remarks upon cases occurring in the ward to which I have been attached as medical officer since July 10, 1862."[135]By doing so he was forced to really think about the dynamics of disease:

> Difficulty must exist sometimes insurmountably in making out an accurate diagnosis of cases brought to a hospital from a distance often with a sickness of several weeks duration, of the character of the early symptoms of which little or no account can

[131]RG 112, (NARA) Entry 63 Central Office Issuances and Forms: Circulars and Circular Letters of the Surgeon General's Office, 1861-1865,Circular Letter issued by Joseph Barnes Feb. 1864. See also John Shaw Billings, *Medical Museums*. Science, Vol. 12, No. 294 (Sept. 21, 1888): 134-136.
[132] He would later go on to do fascinating work related to heart disease. Please see chapter 3.
[133] Henry Hartshorne Papers (1823-1897) Library of the College of Physicians, Philadelphia, MSS 2/0030-01.
[134] Interestingly, in the 1850s Hartshorne, Joseph Leidy and S. Weir Mitchell tried to establish a "biological society" for the development of medical science. But it was unable to survive due to the lack of support for scientific medicine already discussed. The war allowed all three of these physicians to pursue their interests in scientific medicine.
[135] Ibid.

> be obtained. I confess therefore to a considerable delay in making up my mind as to the true character of these cases which have afforded us the most painfully interesting study.[136]

He then prepared a very long and detailed report regarding "scorbutic marasmus" including symptoms, diagnosis, treatment and post mortem appearance which he compared with Dr. Gross:

> In those examined a combination of lesions was observed, which when compared with those of patients who died in the war of the same hospital under care of Dr. S.D. Gross constituted a series of coincidences too striking not to indicate a pathogenic association; even although this might be of an unusual or unexpected nature. The combination I speak of was of follicular colitis with double pneumonia of the posterior portions of the lungs, this was the more remarkable because in several instances, the symptoms usually presented by neither of these affections were well marked. Dysponea and cough were present in three cases for some days and in two the dysponea increased rapidly during the last hours before death. But in several of the most interesting of the fatal cases there was neither cough nor dysopnea nor pain in the chest nor expectoration nor delirium and yet (as in the Snooks case) hepatization of both lungs, with commencing suppuration appeared after death; scarcely any of the patients alluded to complained of abdominal pain and none other of local tenderness or tenesmus.[137]

Case histories accompanying each specimen were analyzed so that a clinico-pathological model could be developed which would show signs and symptoms observed in the patient, with lesions found in the organs at autopsy.[138]The case report became part of a scientific network sponsored by the Union government which provided support for the identification of the prevailing diseases based on empirical observations. The broad range of cases and even the practice of case writing created a community of physicians dedicated to the mastery of wartime diseases. The case report both sanctioned the work and the new Army Medical Museum but most importantly, produced knowledge.[139] In the nineteenth century case reporting was fairly common among elite physicians;[140] however,

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[136] Ibid.
[137] Ibid.
[138] In particular, in the attempt to understand epidemic diseases physicians were asked to note in the case reports symptoms of the disease, the treatment of those diseases and the appearances disclosed at the post mortem. See, RG 112, (NARA) Entry 63 Central Office Issuances and Forms: Circulars and Circular Letters of the Surgeon General's Office, 1861-1865, p. 58. Circular No. 9, issued June 30, 1862.
[139] For the history of case reporting, see Julia Epstein, *Altered Conditions: Disease, Medicine and Storytelling* (New York: Routledge, 1995); Mary Fissell, 'The Disappearance of the Patient's Narrative and the Invention of Hospital Medicine," in Roger French and Andrew Wear, eds., *British Medicine in an Age of Reform* (New York: Routledge, 1991): 92-109. (Eds.) Franca Iacovetta and Wendy Mitchinson, *On the Case: Explorations in Social History* (Toronto: University of Toronto Press, 1998)
[140] For example many elite physicians kept case books while in Paris. See John Harley Warner, *Against the Spirit of the System*. See also, Stanley Joel Reiser, "Creating Form out of Mass: The Development of the Medical Record," in

many physicians drawn into this project were well below this level and by engaging in this work they developed a strong identification with medicine and science particularly relating to practical instruction, diagnosis, treatment and the transfer of knowledge. This was crucially important because it brought more physicians than ever into the domain of medical science through compliance with Circular No.2 and Hammond used the authority of the medical department to ensure that it was enforced. Although this was difficult to ensure, Hammond took the necessary measures. For example, he issued Circular No. 10 as a follow up to Circular No. 2 on August 10, 1862 in which he noted: "many medical officers, both regular and volunteers have partially disregarded previous circulars from this office. These circulars are explanatory orders and in future, officers neglecting to comply with their directions will be proceeded against for disobedience of orders."[141] The structure of the military was new and intimidating for many volunteers helping to ensure compliance:

> Not long after taking after taking charge, one Saturday afternoon about 4 o'clock I received an order to report at the office of Dr. Letterman, the Medical Director of the Army of the Potomac, in Washington. I had had so little experience in army orders that I almost trembled at the formal and peremptory character of the order. I feared that without knowing it I had done something to displease Mr. Stanton, the Secretary of War, who was a good deal of a bogy to most people at that time, for he has a way of putting them sometimes into Fort Delaware or other similar close quarters, without giving any reasons too, which was very disagreeable.[142]

It is clear, however, through the examination of the case reports that physicians were generally eager to comply and their enthusiasm was evident. Their commitment to scientific medicine was now recorded in case histories, autopsy reports, publications, medical lectures, correspondence and they in turn became part of the medical culture and legitimized the work that the case represented by becoming a stimulus to medicine. In July 1864 Joseph Barnes noted in a letter to Dr. Frees that "the medical officers on duty in this city, some of them connected with the AMM want to make that institution practically useful and request permission to deliver a course of lectures on military,

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Transformations and Tradition in the Sciences, ed. Everett Mendelson Cambridge: Cambridge University Press, 1984) pp. 303-316.

[141] Circular No. 10, issued August 10, 1862, Washington DC. Please see RG 112 (NARA) Entry 63 Central office Issuance and Forms: Circular and Circular Letters of the Surgeon General's Office, 1861-1865, p. 58.

[142] W.W. Keen, "Surgical Reminiscences of the Civil War" in *Addresses and Other Papers* (Philadelphia, W.B. Saunders & Co., 1905) pp. 423-424.

medical and surgical medicine in the hall of the museum; the large number of medical cadets and junior medical officers at once suggest the advantageousness of such a course."[143]He went on to note that the lectures would be held in the evening at no charge, and would only require the facilities and contents of the museum for the instruction. Brinton noted that "professional zeal had been excited" simply because collecting specimens placed physicians in the domain of scientific medicine they were forced to identify with the gross pathological specimen, to see the object of disease. He noted that never before in American medicine had there been "so great an activity and development and so earnest an effort to master the unsolved problems of the past."[144]Army surgeon Jonathan Letterman (who would later revolutionize the ambulance system) similarly noted to Hammond that his "idea for the collection and preservation of specimens for the museum is perfectly feasible and can be carried out without difficulty. It always affords me pleasure to cooperate with you in any way possible to advance the interests of the museum, which does so much."[145] Like many physicians, Letterman felt the opportunity of the war should not be lost, "I shall be glad to cooperate with you in any way in my power to amass something out of the dying of this war."[146]

The project, a distinctly American educational intervention, proved compelling for many civil and military physicians and quickly stimulated interest far beyond its initial objectives. George Otis noted: "the museum received contributions relating to collateral subjects...many pathological specimens not specially pertaining to military medicine or surgery and many preparations of human and comparative anatomy had been received, a cabinet of microscopial preparations had been accumulated, models and drawings of hospitals and medical and surgical instruments had been contributed."[147]In a report from Brinton to Surgeon General Barnes, he noted that a central part of the

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[143] Outgoing Correspondence Otis Historical Archives, RG 21. Barnes to Dr. Frees, July 30, 1864. (NMHM)
[144] John Brinton Manuscript Collection OHA RG 124: John Brinton, "Address to the Graduating Class of Jefferson Medical College, April 27, 1892" p.2. (NMHM)
[145] RG 94 (NARA) Scientific and Historical Reports: Records of the Record and Pension Office, 1814-1919,Entry 629, Box 8. Letter from Jonathan Letterman to William Hammond, August 8, 1863. Jonathan Letterman, Medical Director of the Army of the Potomac, by general order Aug. 2, 1862 established the ambulance and evacuation system, supply system and field hospital, which became basic models all over the world. See, Medical Officers who have Made Contributions of Worth to Science of Medicine." Armed Forces Medical Library Document Section, NLM, MS B 281.
[146] RG 94 (NARA) Medical Records, 1814-1919, "D" File, Box One P1-17 Entry 623. Letter from Jonathan Letterman to John Brinton-Dec. 4, 1863
[147] RG 94 (NARA) Scientific and Historical Reports: Records of the Record and Pension Office, 1814-1919 File A, Entry 41. George A. Otis, 'Notes on the Contributions of the Army Medical Museum," Feb. 7, 1878

museum's value is that it is "used weekly and almost daily" by the civil profession throughout the country.[148]Billings similarly recalled:

> What should be the relation of this central national collection to those formed in different parts of the country, either in connection with medical schools, or with museums of broader scope? Certainly they should help one another, and this can be done in many ways...I would say to the anatomist of a school, when you have made a copy for the national collection, where it will be seen by the anatomists of all schools and of all countries. To the pathologist of a medical school...after you have secured type specimens for your own collection put aside other good specimens for the National Medical Museum. On the other hand, the collections of the National Museum are available for study by any proper person, and its duplicates should be used to aid other museums which may be in special need of them.[149]

Physicians were no longer professionally isolated: the publications were vital in creating a network that linked physicians in America (northern and southern), to the wider world of Paris, London and Vienna, in a community of knowledge.[150]The museum's material collections also attracted visitors which reinforced this community of knowledge. Indeed, Dr. J. Murmich of Berlin, a surgeon in the Prussian army, travelled to America to observe medical practice in the United States as well as some of the recent work performed during the war. He requested an exchange of German publications for the *American Journal of the Medical Sciences*. As Joseph Henry noted, "I have informed him that the transmission of the two works, to and from this country can be counted on through the Smithsonian[151] agency."[152] He noted that unlike some anatomical collections this one is not a "museum of curiosities, it is a collection that teaches."[153]Indeed, the collection received high praise from many visitors including Dr. Meusal of Gotha who stated:

[148] Outgoing Correspondence RG 21, Otis Historical Archives. John Brinton to Joseph Barnes, August 24, 1863 Letterbook One, series 5. (NMHM)
[149] Billings, Medical Museums, p. 30.
[150] See, US Army Surgeon General's Office: Correspondence acknowledging Receipt of Circulars 1-7, Box One, MS C 7 (NLM). These were sent to libraries, museums, universities, medical schools, journals and reflect the confidence among American physicians that donating this material conferred.
[151] A. Hunter Dupree noted that Joseph Henry, Secretary of the Smithsonian Institution "specifically recognized the connection of science and warfare" and Henry promised that the institution would "continually render active cooperation and assistance." This assistance ranged from manufacturing "disinfecting liquid" in the chemical laboratory or holding lectures and seminars at the Smithsonian (such as inviting Brown-Sequard to give a series of lectures in 1864), or receiving material for transfer to the AMM or hospitals. Henry also participated in, and supported, the U.S. Sanitary Commission. For more on the Smithsonian Institute during the war please see, A. Hunter Dupree, *Science in the Federal Government: A History of Policies and Activities* (Baltimore: John Hopkins University Press, 1957) Chapter 7.
[152] Isaac Hayes Papers, (APS) B H334, Box One. To Isaac Mini Hayes from Joseph Henry, August 12, 1865
[153] Ibid.

The museum, in view of its aim and origin is very rich in those chapters which are of specific interest to the military physician. The art and manner with which the material was collected gives us a high opinion of our colleagues, who in the midst of the bustle of war have brought it together scientifically. It gives us also a high opinion of the organization of the care of the American Army....to prepare after battle so many careful specimens as e.g. the big list of mortal wounds. They lost no time in preparing specimens of interest and instruction to the observer. The abstracts of case histories are brief and clear, and the numerous illustrations excellent, and the aim to give complete information concerning the course of the disease and the result of an operation, deserves the greatest recognition. The value of many surgical procedures will become established after years. The classification is distinct and the description of individual specimens is the work of endless endeavor and rich knowledge and experience. But besides the rich contents of the catalogue and its excellent preparation, the circumstances concerning that is most startling, namely, that we see for the first time, in effect a printed catalogue of a museum. Through the fact that everybody is able to provide himself with a printed catalogue and that he may orient himself at home as to what he wishes to study, the museum becomes a common possession to all physicians, and ceases to be the private treasure of some academician, difficult of access.[154]

A system of exchanges was made with numerous pathological societies, universities, hospitals and museums in America, Britain and Germany. Publications based on museum work were also sent around the globe along with requests for scientific work of interest to be donated to the museum.[155]Those connected with this work made claim to having specialized knowledge and important information to share; a reflection of the confidence that this project generated among physicians. The publications were American and reflect America's identity as a producer of medical knowledge. In 1870, the *Medical and Surgical Reporter* noted of the medical literature, "In these publications it has been our aim to supply the wants of the greatest number of the profession...our course has been independent and American, and so it will continue to be."[156]The works produced during the war were referenced so frequently afterwards the publishers of the *Medical Gazette* felt compelled to address the issue, "We make no apology to calling so frequently the attention of our readers to the publications of the Surgeon General's office,

[154] Daniel Lamb, *History of the U.S. Army Medical Museum: 1862-1917: Compiled from the Official Records of Dr. D.S. Lamb, Pathologist at the Museum,* (Army Medical Library, Washington, 1917) A report from Dr. Meusal of Gotha, Germany reprinted in Lamb p. 73.
[155] MS C7 National Library of Medicine, US Army Surgeon General's Office Correspondence acknowledging receipt of Circular nos. 1-7
[156] *Medical and Surgical Reporter*, Philadelphia July 2, 1870, p. 18.

because they constitute such important accessions to our original medical literature."[157]It was not a revolution in medicine's ability to cure but rather an opportunity to reorient American medicine along more scientific guidelines.

The medical officers at the AMM framed what they were doing as part of medicine's development and the transmission of this information was important for those involved. This was significant because it allowed for the development of a new research society which both supported and made practicing physicians aware of the work being performed in the museum's laboratory. A central objective of the project was to monitor the changing patterns of disease and examine and record diagnostic patterns. An adherent of French medicine but also a proponent of experimental medicine, Hammond wanted to use the access to bodies that the conflict furnished and the tools for investigating disease that the museum provided, such as tissue pathology, photomicrography, histology, cellular pathology and physiology, to develop new models of medical science. Physicians were asked to identify with the gross pathological specimen, to see the object of disease in a more intimate way than they ever had before. These instructions were new, even revolutionary, to some of the 12,000 physicians who served during the war, and had a profound effect on the individual physician. The physician Edward H. Smith noted to Hammond "if there is any benefit from the sad struggle of the age, it is that medical officers can fully justify looking for information and present the information for the world's future use.....The use of limbs and organs, and operations once deemed experimental will in future use be instilled to our confidence because of the keen, careful, and honoring eye of experience."[158]Indeed the physician C. Wagner wrote to Brinton that he was "desirous to be part of the surgical history of the war," reported that he was "keeping all specimens of interest, case notes written out carefully" and asked Brinton "for any suggestions" on how to contribute effectively so that his preparations would be of value.[159]Soon after Wagner sent Brinton a detailed list of specimens:

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[157] Library of the Surgeon General's Office: Data Relevant to the Library. Box Three, (NLM), MSC 185. Article from the *Medical Gazette*, 1871.
[158] RG 94 (NARA) Scientific and Historical Reports: Records of the Record and Pension Office, 1814-1919 File A, Entry 621. Edward H. Smith to William Hammond, February 3, 1863. He also submitted 6 case studies of wounds of the right leg, left thigh, inferior maxilla, right shoulder, right tibia and left humerus after conducting the studies in Ward D at Satterlee General Hospital (his excitement is clear).
[159] Incoming Correspondence, OHA RG 13 Letter to John Brinton from Dr. C. Wagner, Dec. 26, 1862 (NMHM).

> Please find enclosed a list of the pathological specimens that I have at present on hand. I will have more after a while. The specimens, with a brief history of each case, will be forwarded in due time. I have had several interesting cases of gunshot wounds of the lungs, but cannot procure specimens because the cases will recover. Today I performed an interesting operation: resection of the ulna; removed two-thirds of the bone, disarticulating it at the elbow. I have more operations in prospect. I will send you one very pretty specimen, a portion of the cranium from a case of resection of the cranium.[160]

By 1865 Wagner had become one of the chief contributors to the museum: "I have the honor to transmit by express one half barrel containing anatomical specimens. Reports of both cases of amputation at the hip joint were forwarded several days ago with the quarter's report of surgical operations, in which, cases from whom the specimens were obtained are represented by hospital numbers 6654 & 1995."[161]

For many physicians association with the project conferred individual identity, a way to establish themselves in the medical world, which many saw as being rapidly transformed.[162]The medical world in the third quarter of the nineteenth century was still small, and having the chance to contribute, excel and possibly become established as a specialist or medical expert was an exciting prospect. The sources indicate that the network of physicians that served during the war both sought to impress and learn from each other during this period, suggesting that the Civil War medical world was both competitive and cooperative. The incoming correspondence to the Army Medical Museum illustrates how important this recognition was for the physicians who sent in specimens and case reports to the museum, and how palpable the enthusiasm for learning from Civil War bodies. A letter sent Nov. 8th 1865 by James Armsby, a surgeon in the Ira General Hospital in Albany New York, stated:

> I have the honor to state that I have this day forwarded to your address, for the army medical museum, a box containing an album of photographs of morbid specimens and necrosed bones removed from patients treated in this hospital. Attached to each specimen is a case study. The views in the album are taken from a collection of several hundred in the profession.[163]

There were of course the very interesting cases:

[160] Incoming Correspondence, OHA RG 13 Letter to John Brinton from Dr. C. Wagner, Jan. 11, 1863. (NMHM).
[161] Incoming Correspondence, OHA RG 13 Letter to George Otis from C. Wagner, dated April 21, 1865 (NMHM).
[162] See, the Silas Weir Mitchell Papers Library of the College of Physicians, Philadelphia. MSS 2/0241-033, Box 11.
[163]Incoming Correspondence, OHA RG 13 James H. Armsby to Joseph Woodward, Nov. 8, 1865. (NMHM).

I take this opportunity to send you the bones of the leg which Brig. General T.W. Sherman USV lost in consequence of a gun-shot wound received May 27, 1863 at the first assault of General Banks upon Port Hudson. I regard the specimen of interest both from the distinguished reputation of the patient and from the extraordinary character of the treatment which he received. The General was brought to New Orleans about three or four days after he was wounded. The wound in his leg which was extensive and greatly lacerated (having apparently been produced by a conoidal ball) was very tightly sewed up with a continuous suture, the cutting out of which gave exit to a large discharge of decomposing coagula pus and bone splinters. I need scarcely say that when Gen. Sherman reached New Orleans his constitutional symptoms were of the most aggravated character. He remained in a most discouraging condition for nearly two weeks when amputation through the middle of the thigh was performed by Dr. W Stone, a civil surgeon, and resulted favorably.[164]

But most reports simply reflect the interest in being able to contribute to the project and to produce knowledge that would benefit American medicine. The physician John A. Murphy sent Hammond "a history of a very interesting case treated in this hospital, I also send you now the pathological specimen marked pathological specimen no. 2"[165]H.K. Neff wrote to Brinton from Camp Letterman: "I have numerous specimens for you and have packed them in ale with some whiskey and chlorismatia Inda—we have more in the ground and will have more everyday for a month to come."[166]Similarly, William Thompson an assistant surgeon at the Douglas Hospital, sent in a number of pathological specimens throughout the war, and provided detailed histories with his submissions. For example, in the case of M. Paquet a private from New York who had been struck by a bullet at Chancellorsville May 3, 1863, Thompson treated him for a flesh wound over the 9th rib and a subsequent attack of erysipelas. The patient was treated with tincture of iodine and doses of bromine but was later diagnosed with "acute bronchitis."[167]The patient died 16 days after being admitted to the hospital and Thompson performed the autopsy 6 hours later:

There were adhesions in the right pleural cavity; with serum in both pleural cavities. The mucous membrane lining the bronchial tubes was strongly injected: both lungs seemed to be much congested sinking in water, but with no hepatization. A fracture surrounded by

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[164] RG 94 (NARA) Scientific and Historical Reports: Records of the Record and Pension Office, 1814-1919 File D. Entry No. 44 New Haven Conn. Jan. 14, 1863 Prof. Frances Bacon: Case of General Sherman. Specimen AMM 3604 .

[165] Incoming Correspondence, Otis Historical Archives, RG 13. John A. Murphy to William Hammond, Feb. 28, 1863. Incoming Correspondence (NMHM).

[166] Incoming Correspondence, Otis Historical Archives, RG 13 H.K Neff to Brinton, August 6, 1863, (NMHM).

[167] RG 94, (NARA) Scientific and Historical Reports: Records of the Record and Pension Office, 1814-1919 File A Entry 171 "Special History of Pathological Specimens Forwarded to the Army Medical Museum." Specimen History 1341.

fibrous investment and in a fair way to be united of the radius was found and is now forwarded. This will make a valuable wet specimen.[168]

William Williams Keen also wrote Brinton regarding the project: "I have received the catalogue of the museum and looked it over. I am glad to see such a valuable collection. Can you send me another copy for me to send to Dr. R. Davies, who was my temporary successor at Frederick? He has returned to England and I know he would like to have one [particularly because Davies published in Hay's American Journal on specimen 881 of the catalogue.]"[169] Being associated with this work was important to Keen: "I sent a photograph of case 557 by mail. It is not noted I see, and if it was not received, Dr. Weir at Frederick can supply you with another and Dr. Gurdon Buck of New York can give you further information as to the case for he was to go there to have a plastic operation performed."[170] On another occasion physician R. Weir wrote Hammond on behalf of Keen: "Dr. Keen forwarded today the barrel containing specimens from the General Hospital in Frederick and would like Brinton to forward all the numbers that these specimens will be catalogued as in order to ensure that the hospital gets due credit for the specimens, particularly because they are of value."[171]

Keen's case notes are revealing. Confidence in his abilities as a medical professional can be clearly seen developing through the war. Keen began at Jefferson Medical College in the fall of 1860 and as he pointed out he was fortunate enough to have made friends with faculty members John Brinton, Jacob DaCosta and Silas Weir Mitchell. (They would later work together during the war and formed life-long professional alliances). Keen credited his mentors with instructing him in the basic principles of scientific medicine: "If I had not entered the office of Brinton and DaCosta I would have graduated without ever having looked through a microscope, ever having personally examined a patient or written a prescription."[172]Indeed, "two or three days later I was sitting at one of the windows with Gray's Anatomy [a new book then] on my lap and a skull in my hands beginning the study of bones. Minutes later S. Weir Mitchell

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[168] Ibid.
[169]RG 94 (NARA) Entry 623, Records of the Adjutants General Office: Medical Records, 1814-1919 "D" File W.W. Keen to John H. Brinton, May 2, 1863. Box One.
[170] Ibid.
[171] Incoming Correspondence, Otis Historical Archives, RG 13 Letter from R. Weir to Hammond Dec. 12, 1862. (NMHM).
[172] Keen Papers, An Autobiographical Sketch by W.W. Keen" B K245 (APS) p. 28.

came in the room and asked if I wanted to help him with some experiments on snakes. This is the beginning of a friendship that has endured for over 52 years."[173]Keen became part of an alliance that was very interested in the pursuit of scientific medicine. They were able to transcend the limitations of the antebellum medical world by volunteering for medical service in the war. (Brinton, DaCosta and Mitchell all served to promote the development of the medical sciences during the conflict.) Keen was very inexperienced when he sought, and received, a commission during the war. As he noted:

> How vividly I recall my first operation on a living patient—a simple amputation of the forearm in an army hospital in 1862. I was greatly alarmed after the very first incision lest the patient might bleed to death before I could secure the arteries. I remember well that shortly after I asked an older surgeon to amputate for me at the shoulder joint. Though I had often done it on the cadaver, I shrunk from doing it because I was afraid of hemorrhage. I ended by being as little afraid of even the most furious hemorrhage as anyone could possibly be. If it did occur I met it with imperturbable coolness, sure of my mastery by means I had often used with success. This is the severest test of an experienced surgeon. When the warm blood is gushing as if from a fire plug over the hands of the surgeon and he knows that it can continue for only a very few minutes without destroying life, if he can retain his equanimity his perfect mental poise give his short sharp orders and adopt almost by intuition just the right means for arresting hemorrhage then he can be implicitly relied upon.[174]

As early as 1863 Keen was quite at ease with surgery and many other aspects of scientific medicine; during most of his service in the army he was an agent of the Army Medical Museum and collected specimens from all the hospitals in Frederick, Maryland and later Philadelphia and forwarded them to Washington.[175]He remarked after the war: "My own notes and specimens fill many a page and furnish many an illustration in the six splendid volumes of the *Medical and Surgical History of the War.*"[176]Keen's developing proficiency and familiarity with the body progressed rapidly during the war. His reports to Brinton reveal his enthusiasm for the project: "please find enclosed a heart and an aortic valve of which are beautiful pathological specimens and a number of lungs from pyaemic cases."[177]He also submitted "the case reports for specimens 874 and 834 belonging to the same case and in my series respectively ("arterial specimen" no. 8 and

[173] Ibid. p. 29.
[174] Ibid. p. 108.
[175] Ibid. pp. 31-32.
[176] Ibid.
[177] RG 94 (NARA) Entry 623, Records of the Adjutants General Office: Medical Records, 1814-1919 "D" File W.W. Keen to John H. Brinton, May 2, 1863, Box One.

specimen no. 100) along with a full statement of the case, as I obtained the bone and the artery on a post mortem, I also wrote up the case notes and credited myself with the case."[178]Keen, like many physicians, was able to use the war experience to develop a scientific identity. For others it could be a source of professional embarrassment to be reprimanded for not participating. As one physician noted when asking for a copy of the circular, "I am constantly embarrassed in the performance of my duties for the want of them [circulars]."[179]

The museum proved a stimulus to the development of science by providing intellectual support to allopathic physicians, a physical location in which to investigate disease and institutional support for the production and dissemination of ideas. In 1865 Joseph Woodward wrote to Alfred Stille, with whom he had enjoyed "agreeable intercourse" during their time at the *Philadelphia Pathological Society,* to discuss his on-going work in the museum's laboratory related to pathological anatomy and histology:

> I am desirous of inviting your attention to the studies at present in progress here under my supervision as to the diseases of our soldiers. The studies are assuming the more importance because of the bearing of the facts observed on general pathological doctrines. If for instance my preparations prove in the thickened peyers glands of our camp fevers and the swollen hardaceous connective tissue of the colon of our camp diarrhea, a cell multiplication of preexisting elements instead of the free cell development in a plastic exudation which appeared probable to those who teased fragments instead of cutting sections: this fact once established must lend its aid to the general reception of the modern doctrines of new formations, as versus, the older conception which is still so generally received in this country.[180]

Woodward invited Stille to Washington to examine the medical and microscopial collections which had been acquired in "ample proportions." He concluded "I should much like to show you what we are doing and to converse with you on some of the views to which my observations are compelling me."[181]Woodward was an eager student and sent numerous letters asking to exchange specimens for the purpose of comparing diagnoses in the attempt to understand causation and transmission of disease. The exchange of information and transfer of knowledge was vibrant and supported

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178 Ibid.
178 Ibid.
179 RG 112 (NARA) Office of the Surgeon General, Letters Received 1818-1870, Entry 12, Box. 21. A.B. Campbell to Hammond, May 9 1863.
180 Woodward to Alfred Stille, Jan 20, 1865. Joseph Woodward Letterbook, Otis Historical Archives, RG 28 (NMHM)
181 Ibid.

Hammond's objective that American physicians become producers of medical knowledge. Much of the focus during the war for Woodward was on the pathological anatomy of camp diseases, particularly diarrhea and dysentery, which resulted from overcrowding, poor hygiene and malnutrition, and were the most debilitating diseases to the Union army.[182] Woodward detailed the effect of region and season on the cases of diarrhea and dysentery, studied the body during autopsy and the specimens (normal and diseased) and the microscopic appearance of the bowel. These gross and microscopic descriptions and pictures were intended to provide instruction on diagnosis and a basis for comparison so that American physicians could study the results of the work being produced at the museum in the context of their own experiences. Woodward's chief objective was to develop a medical model for understanding camp diseases, which would be supported by the exactness and precision of the laboratory and marked by standardization and efficiency, regarding the etiology of disease. He wrote to Surgeon M.K. Taylor in regard to their differing diagnoses of chronic diarrhea based on independent pathological investigation:

> I learn from surgeon Getty that you have collected a number of specimens which you intend to forward to the museum. The doctor is under the impression that you have found ulcerations of the intestine very rare in these cases. As a fellow-student of the same subject this statement has interested me very much and the more so because at the museum I have found ulceration the rule in cases fatal from the diarrhea, and this in specimens from the west and south as well as from the east. What I have seen here has led me to believe that the most frequent form of chronic diarrhea in the army is a chronic colitis in which thickening and softening of the mucous membrane with enlargement of the solitary follicles is followed by ulceration of the latter, the ulcerations most frequently small (pin head ulcers follicular ulcers) but extending in severe cases and especially in scorbutic cases to jagged erosions of considerable size. I have some hundreds of preparations in illustration of these views. Will you favor me with a reply to this telling me what you have really observed? I need not say that I shall be most pleased to receive the specimens at the museum whenever you are ready to forward them and their histories.[183]

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[182] Civil War physicians often used the terms diarrhea and dysentery to mean the same thing (though dysentery was often differentiated by the blood in the stools). Among union troops there were 1,528,098 reported cases of acute diarrhea and dysentery, and more than 40,000 Union deaths. *Medical and Surgical History*, Part II, Vol. I pp.401-402; 799-800.

[183] Joseph Woodward Letterbook, Otis Historical Archives, RG 28 (NMHM.) Woodward to Surgeon M.K. Taylor Sept 2, 1864. Autopsies were similarly important in illustrating to physicians that disease states were specific: similar entities in every body, place and time.

These diseases provoked much study and proved a great stimulus for the development of scientific medicine. Henry A. Martin from the General Hospital at Scranton, Missouri wrote to Woodward:

> The hospital at this place in my charge is of 202 beds and always full; the cases are largely of what is called chronic diarrhea—chronic dysentery really a disease infesting every army in every country and every season. The disease par excellence, of the army and on which nothing original really satisfactory has been written since the time of Pringle (whose remarks though sound are by no means full)—I have made many post mortem examinations in these cases and propose writing with what scant leisure I have on the subject for transmission to your office. If you should consider it for the interests of the service to send me a microscope of moderate power, it would be a great assistance to me in examining the various and remarkable changes in the intestinal mucous surface to be observed in this disease. I should also like a strong lens or loupe. I have made a requisition on the medical storekeeper at St. Louis for several books—Dalton's physiology—Virchow's Pathology –Bennetts Practice—Erichsen's surgery I am very desirous to get them if you consider that it is for the interests of the service that I should have them and the microscope. I shall be very obliged by your giving such directions as may procure their being sent to me.[184]

The case reports that were submitted to the museum shaped the course of the project but also the relationship between the elite and the rank and file. In many instances young physicians wrote to the museum staff for information on the specimens which they had preserved. Woodward responded to Surgeon W.L Faxon regarding a spleen he had sent to Woodward. The latter responded shortly after noting, "In reply to your note of March 6 which I have delayed to answer until I could study the spleen, I have this to say: The disease of the spleen on careful examination proved to be a metastic focus similar to the pyemic abscess. This condition of the spleen is not uncommon in an ulceration of the intestine and pneumonia both of which are present in this case."[185]The cases studied were to be dynamic, an attempt to master the scientific pulse of medicine and learn from the bodies under the care of the military. The case reports are fascinating and while some were written in haste or from memory there are hundreds which reflect the physicians' desire to learn and develop their expertise. The demand for case reports proved a valuable tool in exposing the weakness in both the skill and training of many American physicians particularly regarding diagnostics. Training physicians properly to diagnose disease and

[184] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870, Entry 12, Box, 66. Henry A. Martin from the General Hospital at Scranton, Missouri January 18, 1863 to Woodward.
[185]Joseph Woodward Letterbook, Otis Historical Archives, RG 28 (NMHM). Joseph Woodward to W.L Faxon April 4, 1865.

understand the dynamics of disease and wounds thus became the central component of the project. Physicians were asked to examine the cause and course of disease rather than merely external factors (theories of diseases will be discussed in chapter 2), which led to a more thoughtful relationship with the etiology of disease. Moreover, it was a chance to see many cases, the unfamiliar and the more commonly encountered, which gave many physicians an easy recognition of disease (though there were of course many misdiagnoses) the cases allowed a record of disease to be established which was commensurate with medical knowledge in 1865. Specimens and photographs provided a record of this work; for example Morris Hyatt Co. A 142nd Ohio, who was admitted July 28, 1864 to Douglas Hospital with typhoid fever and pneumonia died on August 1. His case report noted that, "both lungs at the autopsy were engorged posteriosly and contained globules entirely hepatized throughout the small intestine, the solitary follicles and peyers patches were found enlarged. The photograph gives a faithful representation of one of these patches."[186]It was common practice to illustrate the effect of disease through photographs. Clinical photography developed in Europe in the 1840s, but found its first application on a significant scale in America during the Civil War. (See Chapter 3 for further discussion). R. Weir sent the museum, "206 specimens (wet and dry) with histories as complete as possible, also 53 photographs representing various fractures and apparatus."[187]

These reports are inquisitive and illustrate the thoughtful analyses of "interesting cases"; information was readily exchanged and more information was often solicited. By engaging in this work physicians became part of a shared experience; in this instance it was saving the national body, a medical distinction previously unseen in America, which allowed physicians readily to identify with colleagues who were interested in the same areas of medicine. Contributing to a body of work made transparent by the body of records that accumulated brings up another important theme: accountability.[188]Physicians had to be responsible for the decisions they made, including

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[186] RG 94 (NARA) Scientific and Historical Reports: Records of the Record and Pension Office, 1814-1919 File A, Entry 103. "Histories of Pathological Specimens prepared and forwarded by William Thompson, Douglas Hospital" Case of Peyer's Patches enlarged and thickened and enlarged mesenteric glands."

[187] Incoming correspondence, Otis Historical Archives, RG 13 Letter from R. Weir to George Otis, Oct. 19, 1865. (NMHM).

[188] Walt Whitman pointed out that a "large number of visitors to the hospitals do no good at all, while many do harm…the surgeons have great trouble from them. Some visitors go from curiosity-- as to a show of animals. See, Walt

the performance of an operation or amputation and the administration of therapeutics; if they deemed a patient "cured" and he rejoined his regiment at the front, the doctor was then accountable to himself and the patient.[189]The case report also made the doctor accountable to the government, the Surgeon General and the public; however, perhaps most importantly, the doctor was accountable to his profession, which sought to move medicine into a more scientific stage. Case reporting also supported the development of a class of "experts" because this enterprise supported the model of knowledge that emerged and legitimized government support. More practically, the emergence of "expert authority" provided an opportunity and even demanded further study and reflection on disease. On June 14, 1864, for example, Joseph Woodward wrote to a young doctor in the field to correct him on his recently submitted case study.

> I have to thank you for the interesting specimen in the case of Mason. You are however quite wrong in supposing the disease to be tubercular. Its characteristics the size, shape, of the tumor and the microscopial appearance all show the disease to be undoubtedly <u>medullary cancer.</u> You will I know pardon criticism on your diagnosis for the sake of truth. In a general way tubercules contain such size as these tumors. And, microscopically, the tubercule never contains such ulcerated cells as are presented in this specimen. I have had the specimen prepared for mounting and it will make by far the finest cancerous preparation in the museum, which is by the way enriched by numerous contributions from you.[190]

Woodward liked especially to study cases from the field to both learn and confirm correct diagnoses. In another interesting case Woodward observed in a letter to Surgeon L.S. Todd, 4th Calvary volunteers, San Francisco August 15th 1864:

> Your specimen from Private Leo Monier Co. "B" 4th cavalry voluntary infantry has come to duly to hand. You will be interested to learn that a profound and exhaustive microscopial examination of this specimen by assistant Surgeon E. Curtis of this office and myself has satisfied me that this specimen does not consist of detached mucous membrane, but of complete fibrinous cast of the bowels similar to what occurs from

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Whitman, *The Wound Dresser* (Small, Maynard and Co. Boston, 1898) p. 33. A resolution of the senate passed July 19, 1861 said that all newspapers were to publish the name, location of each hospital and the number of sick and wounded of the various regiments along with the surgeon in charge, which made medicine transparent. See, RG 112, (NARA) Central Office Issuances and Forms: Circulars and Circular Letters of the Surgeon General's Office, 1861-1865, Entry 63 p. 42.

[189] Circular No. 2 also asked that physicians detail the conditions requiring operations, especially amputations and exsections, along with details relating to all "important cases," which were to be reported in full. See, RG 112, (NARA) Central Office Issuances and Forms: Circulars and Circular Letters of the Surgeon General's Office, 1861-1865, Entry 63. p. 26. Circular No. 6 issued by Hammond July 14, 1862 asked that medical officers in charge of hospitals "make special and careful examination of all convalescents under their charge, and cause all who are fit for duty to be returned at once to their regiments." Ibid, p. 52.

[190] Joseph Woodward Letterbook, Otis Historical Archives RG 28 June 14, 1864. Woodward to Assistant Surgeon Henry Stone. (NMHM.)

bronchial tubes in diphtheria. **Such casts are far from uncommon in dysentery, but this is the first which has been deposited in the army medical museum.** Thanking you for the specimen and history.[191]

Joseph Woodward developed a career and an identity through his work at the medical museum. He was more adept in his work relating to the development of photomicrography and microscopy (to be discussed in chapter 3), than he was at recognizing the microorganisms that caused disease. (His work has been overshadowed by his failure to recognize the specificity of typhoid fever and malaria, and his contributions to medicine have been somewhat undermined by his incorrect assertion of the existence "typhomalarial" fever.)[192]As a pathologist and microscopist Woodward's defining characteristics were developed in relation to and reinforced a specific set of criteria by which to investigate disease processes. In other words, while he did not recognize the microorganisms that caused disease, he challenged the way in which disease was traditionally studied: it was now about the examination of diseased structures and morbid secretions, and the work at the museum garnered support for this epistemology to develop. It was sponsored by the government and supported by some of the 12,000[193] volunteer, regular and civilian physicians who submitted specimens and reports creating a new infrastructure for medicine.

Post-Mortem Inquiry as a tool of Scientific Investigation:

Circular No. 2 also requested that physicians diagnose and monitor cases, and in the case of death, perform an autopsy. The circular proved significant in the development of this research tool and it was important for the development of scientific medicine that physicians become acquainted with anatomy: the structure of the body and the functional relation to that structure. The Army Medical Museum supported the development of the professional physician, who could perform the autopsies required. It also provided bureaucratic management or institutional support for this medical system to develop. Hammond demanded that autopsies should be done in all "interesting" or

[191] Joseph Woodward Letterbook, Otis Historical Archives RG 28 May 25, 1864. (NMHM.)
[192] Joseph Woodward. "Brief rejoinder to some recent articles by Dr. Roberts Bartholow." *The Cincinnati Medical News*, (Nov. 1877) Vol. X No. 119. For more on typhomalarial fever please see, Dale Smith "The Rise and Fall of Typhomalarial Fever: I. Origins." *Journal of the History of Medicine and Allied Sciences* 37 (April 1982): 182-220.
[193] Approximately 12,000 physicians served during the war (northern and southern physicians) as listed in the 1860 census. See, Blustein p. 25. However, as the war went on numerous more physicians served in various capacities. See, Silas Weir Mitchell Papers, Library of the College of Physicians, Philadelphia, MSS 2/0241-03, 1850-1926.

"important" cases as a matter of professional interest.[194]Perhaps most importantly, Circulars No. 2 and 5 required that physicians leave behind a record of this work, which was displayed in the museum and captured in the case notes. As homeopathists had feared early in the war, this work or master narrative made the collection of specimens and autopsies routine and supported the emergence of a national medical identity which was rooted in scientific medicine.[195]

Today autopsies are used to confirm diagnoses and learn from medical mistakes. The objectives were not very different during the war. Autopsies were a research tool, an attempt to learn from the bodies under the care of the military. Post mortems as a research tool were not a new impulse among American physicians. John Harley Warner suggests that "autopsies were the corner stone of the Paris program: direct observation of symptoms in the living body and pathological lesions in the deceased" and that support for this program was so strong that those who studied in Paris believed this was the "epistemology that would transform American medicine."[196]But it did not, at least initially. There was limited opportunity in antebellum America to inculcate this medical system, and it was not until the war years that the options for anatomy changed for the "many" physicians. It is true that the orthodoxy sought to develop the "Paris Program" in America in order to be on the same footing with elite physicians and European medical science; but the limitations already discussed made this medical system slow to become the cornerstone of the American program. The war was a chance to put science on firmer ground by showing the utility of studying the massive number of cases of disease, their manifestation and the body. During the war years, as Joseph Woodward observed, autopsies and the study of specimens allowed doctors to see the "pathological alterations" of disease; through the many post mortems physicians could

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[194] RG 94 (NARA) Records of the Adjunct General's Office, Records of the Record and Pension Office-Medical Records: Reports of Diseases and Individual Cases , 1841-93. (File A and Bound Manuscripts) Entry 1 Box 2. In October 1862, Hammond requested that surgeons in charge of general hospitals submit reports on cases of special interest, including autopsy reports "accordance with orders sent out in Circular No.2" Issued May 21, 1862, Washington DC. RG 112 (NARA) Entry 63 Central office Issuance and Forms: Circular and Circular Letters of the Surgeon General's Office, 1861-1865, p. 26.

[195] For Medical Narrative, see Cheryl Mattingly and Linda C. Garro, eds. *Narrative and the Cultural Construction of Health and Healing* (Berkeley: University of California Press, 2000). For Identity formation through dissection see Michael Sappol, *A Traffic of Dead Bodies.*

[196] See John Harley Warner, *Against the Spirit of the System: The French Impulse in 19th Century Medicine* (Princeton: Princeton University Press, 1998); For anatomy and medical authority see, Russell Maultiz, *Morbid Appearances: The Anatomy of Pathology in the early 19th Century* (Cambridge: Cambridge University Press, 1997); Helen MacDonald, *Human Remains: Dissection and its Histories* (New Haven: Yale University Press, 2005).

accumulate an accurate picture of disease by gathering the empirical observations from a large number of patients suffering myriad diseases.[197] Physicians could for the first time study the diseases they found within particular organs and tissues and this work challenged the older belief that disease was the product of the whole body. This opportunity to master the body was compelling for many physicians, but then there had always been a fascination with the autopsy both for its utility and the sense of professional achievement this mastery provided. As Michael Sappol suggests, "anatomy conferred authority and legitimacy because it worked: it expanded the technical repertoire and proficiency of medicine."[198] During the war, autopsy was no longer about denigrating the body (which is how the public tended to view the autopsy).[199] Knowledge of anatomy became of national importance. Doctors performed autopsies to understand disease, to save the national sick and to provide the cornerstone upon which scientific medicine could develop.[200] Autopsies provided a lens into the body for physicians to understand the ravages of the diseases that attacked the troops and thus aided diagnoses. This was a way to frame the development of scientific medicine so that the public would support the autopsy rather than see it as a violation of the dead (to be discussed in chapter 4). Because the military claimed ownership of bodies during the war, the body could become an important source of knowledge—an investigative resource that had previously been a scarce commodity. For the first time, physicians could bring pathology into medical practice on a large scale promising intellectual vitality and perhaps professional legitimacy.

Physicians were initially informed that the body was not to be mutilated unnecessarily; examinations were to be made of "those parts that will furnish information regarding the nature and history of the case" and the context of wound or disease, the effect of disease, rigor-mortis; expression on the face at the time of death (in the attempt to determine level of pain) and the external aspect of death were areas to be addressed in

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[197] See for example, Circular No. 6. RG 112 (NARA), Entry 64 "Original and Rough Proof of Circular No. 6: War Department Reports on the Extent and Nature of the Materials Available for the Preparation of a Surgical History of the Rebellion" Surgeon General's Office, Washington Nov. 1, 1865. By illustrating these cases in the medical history of the war it was intended as a diagnostic aid, record of the war but also an achievement of the war doctors.
[198] Sappol, p. 95.
[199] Sappol, pp. 99-131.
[200] In particular, the teaching of anatomy, which required bodies, could lead to the development of other areas such as pathology, physiology and specialized fields like histology, cellular pathology and embryology. To be examined in chapters 2 and 3.

the case report.[201] The historical record illustrates two very different sets of evidence pertaining to autopsies. The experienced physician, working in a general hospital, generally had many pages of observations and analyses relating to each autopsy. They were detailed, thoughtful and a mark of the physician's experiential separation from the "masses." These sources show more thorough analyses of the body; although the organ affected by disease was studied most, there was attention to the entire body in the attempt to understand either the path of the missile or the effect of disease, along with the body generally. There was still reliance on clinical information, but since that was not always available, many reports were conducted in isolation from clinical facts and are thus nicely analytical. The second set of sources consists of the standardized forms issued during the war as a tool to enable the less experienced physician to participate, and learn from this area of medicine.[202] These were primarily used at field hospitals where there was not as much time for thorough study and reflection. It was common practice to focus on the immediate cause of death rather than on the entire function of the body. Tracing the missile through the body in the attempt to anticipate the damage caused by weapons was the objective and provides an interesting lens into post mortems in the field. The body was still used, however, as a resource in which to develop military medicine for the benefit of future wars.

The physician John Woodworth, Medical Inspector of the Army of Tennessee during the Atlanta campaign, performed and supervised a number of post mortems at Field Hospital 15. Post mortems were made in about 80% of the cases.[203] The case reports are short and illustrate the wound, treatment, cause of death or complications, and the post mortem. For example, John Thompson a Private of Company B of the 83rd Indiana Volunteer Infantry was admitted to the hospital after being injured at Kennesaw on the

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[201] RG 94 (NARA) Entry 623, Records of the Adjutants General Office: Medical Records, 1814-1919 "D" File. John H. Brinton to John L. LeConte, November 15, 1863.

[202] The Standardized form consisted of 6 categories including: 1. secto cadeveris; hours after death, rigidity of body, degree of embonpoint, other former wounds or disease, state of body as to composition. 2. Head: scalp, calvaruium, meninges, medullary substance. 3. Chest: pleural cavities, pericardium, lungs, heart. 4. Abdomen: peritoneal cavity; solid viscera; liver; spleen; kidneys; hollow viscera; stomach; intestine; bladder and ureters. 5. Blood-in veins and heart; Urine- in bladder, and before death if possible. 6. Remarks (in which there was a large space for impressions). See, RG 94 (NARA) Entry 623, Records of the Adjutants General Office: Medical Records, 1814-1919 "D" File, Box Four.

[203] RG 94 (NARA) Records of the Adjunct General's Office, Records of the Record and Pension Office-Medical Records: Reports of Diseases and Individual Cases, 1841-93. (File A and Bound Manuscripts) "Cases of Post Mortem and Examinations Made at Field Hospital 15th Army Corps by order of Dr. John Woodworth, Medical Inspector of the Army of Tennessee During the Atlanta Campaign." Box 16.

28th of June, 1864. His case file noted that the wound "badly lacerated the muscles of the thigh," the femur was "fractured very high up" and the leg was "very painful and much swollen."[204] He was treated with cold water dressings to the leg and morphine for the pain. The patient suffered with a fever and nausea until he died 8 days after his admission to the hospital. During the postmortem the femur was found to be badly shattered "from two inches below the greater trochanter (upper bony section) downwards, about four inches several fragments were entirely separated from their attachments." The muscles were "badly disorganized and a fragment of shell weighing nearly ½ lb. was found buried beneath the facia of the thigh." The report concluded: "I have the piece of shell, also the fragments of bones preserved which are at your disposal."[205](Numerous projectiles along with bones and wet specimens were sent to the AMM to give a more rounded story of the war). Similarly, Sergeant J.K. Hillard, Company A of the 121 Pennsylvania Volunteers, had been wounded at the Battle of Gettysburg by a minie ball, which had entered on the right side of the chest, and which came out through the inner border of the scapula about two inches above its apex.[206] His case report noted that upon admission to the hospital the patient was "broken down in health; feeble, anemic, tongue furred and having a dusky hue of countenance"; while the "wound of entrance looked well the exit was sloughing and discharging ichorous pus and the soft tissue around the scapula were boggy."[207]He was treated with milk punch, beef essence and tonics and the wounds were dressed with a fermented poultice. The wound was cauterized to stop the spread of erysipelas and sloughing, which was followed by "profuse diarrhea and vomiting." Despite continued treatment the patient died three days later:

> A post mortem was made 8 hours after death. In the case of each lung were found a few scattered tubercules with some hypostatic congestion. All the other organs were healthy. On examining the course of the wound it was found that the ball had run round on the upper border of the third rib and out behind as noted above. A large abscess was found under surface of the scapula—that bone in fact denuded of its periosteum. Death had evidently occurred from extreme exhaustion dependent on his condition.[208]

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[204] Ibid. "Case of John W. Thompson" submitted by Geo. W. Wilson.
[205] Ibid.
[206] RG 94 (NARA) Records of the Adjunct General's Office, Records of the Record and Pension Office-Medical Records: Reports of Diseases and Individual Cases , 1841-93. (File A and Bound Manuscripts) File A Entry, 171. "History of Pathological Specimens Forwarded to the Army Medical Museum." Case 2792: Gunshot fracture of the Scapula; death of sloughing and exhaustion submitted by H.M Bellows, Asst. Surgeon, USA.
[207] Ibid.
[208] Ibid.

While some of the post mortems performed in the field lacked extensive analysis, that was not always the case; peculiar or unfamiliar cases provoked still more thorough examination. For example Henry Johnson, a Private from the Illinois Volunteer Infantry, entered the field hospital with a gunshot wound of the right arm fracturing the humerus bone that connects the shoulder to the elbow. A resection of the middle third of the humerus had been performed prior to his arrival at the hospital. Upon admission his case file noted that the patient was "very pale emaciated, anemic, very restless and fitful complaining of pains in the legs and suffering from slight diarrhea."[209]He was treated with quinine, milk punch, opium, ale tinc. ferri chloride for a week, at which time it was noted that "the diarrhea is a little better, the pulse which had been very frequent and feeble all the time became a little less frequent and feebler."[210]He was given tapioca, wine, milk punch, and morphia." On July 13, twelve days after admission his case report noted that "the wound which had looked well up to this time, now discharged a little chocolate colored fetid matter."[211]The patient died the next day; it was observed that "his mind seemed somewhat deranged" and it was "learned that he acted strangely while with his regiment."[212]The physician, cognizant of the clinical notes, then looked for clues as he performed a rather detailed post mortem:

> Five hours after death, the corpse is much emaciated, of a waxen paleness, animal heat not yet gone—lungs sound, the fore part of both lungs pale and bloodless—the apex on both sides presented a few old adhesions to the pleura castalis—heart, pericardium contained an unusually large quantity of serum, about 6 ounces of a clear yellowish color—the heart itself was rather small, the left ventricle empty, except a small fibrinous coagulum which extended into the aorta—left auricle empty—in the right ventricle a little blood coagulum—liver sound, stomach and all the intestines much contracted—the stomach contained little fluid of a yellowish and green color—the mucous membrane of it a little injected—the smaller intestines contained a smaller quantity of thin bile-the rectum a little greenish fluid—no inflammation, the surface of all the intestines white, bloodless—mesenteric fluid sound—skull unusually thin , a few places even. Brain—in opening the skull the dura matter was found rather strongly attached to the skull along the sutura coronaria, blood vessels injected with blood, seemingly old adhesions—the soft part of the cerebra opposite the crista galli contained between its layers a thin piece of bone, about one inch long, a quarter of an inch wide and as thick as a playing card, with

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[209] Ibid. "Case of Henry Johnson" submitted by Frederick Hohly, Surgeon of the 37th Ohio Volunteers.
[210] Ibid.
[211] Ibid.
[212] Ibid.

smooth irregular edges—the side ventricles sound—the brain if anything was a little softer than usual.[213]

But overall the postmortems performed in the field hospital were largely empirical and provided thousands of observations on the effect of missiles, in the hope that the experts at the Army Medical Museum would profit from this information. These case notes give an excellent record of medical practice during the war; but were equally important in the development of science: post mortems as a tool of inquiry became routine, allowing physicians the opportunity to become conversant in pathological anatomy even in the most difficult circumstances.

The general hospital records reveal that the order to perform autopsies led to a new medical model which supported investigative medicine and pathological specialism. For elite physicians this hospital experience was the apex of medical science. Hospitals furnished clinical material for analysis, and physicians were encouraged to emphasize the clinico-pathological correlation of their cases. There are thousands of case reports, and in most cases postmortems were performed not longer than 24 hours after death (usually within 12 hours or less). Medical inspector John LeConte demanded that physicians be thoughtful and careful when performing surgeries and autopsies. In addition to the case history he also wanted surgeons to state "distinctly his reasons for considering the operation necessary," the description of the anatomical lesion, the nature of discharge and in the case of death a separate blank was to be used for noting all postmortem observations.[214] In other words, a more careful and measured approach to studying patients and disease was encouraged in this context. Circular No. 2 thus supported the development of a new research structure which encouraged the practical study of bodies and the encouragement of the transfer of knowledge among physicians. Through the examination of case records it is also clear that physicians became extremely confident in their handling of the body. This had not always been the case. W.W. Keen, for example, recalled a case early in the war in which his patient died from an adverse reaction to chloroform and his postmortem notes are particularly revealing as to his state of knowledge prior to the war:

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213 Ibid.

214 John LeConte Papers (APS) B L 493.

> I had sawn all across the forehead and then swept the saw gradually towards the temple. With the first full sweeps of the saw to and fro suddenly the patient loudly champed his jaws at us several times: My assistant instantly dropped the head and leaped backwards holding up both hands in horror and exclaimed "good god isn't he dead." My heart gave one great convulsive leap then stood still then began to beat at race horse speed while I was gasping for breath. And no wonder. Consider all the circumstances—a callow youth just graduated his first fatal case—the sudden death—the influential relationship—the possibility of civil or military inquisition with its uncertain outcome the scalp on the top of the head wholly torn loose and the top of the skull half sawed off in those pre-antiseptic days a surely mortal wound of the man was not really dead and this sudden seeming protest of the corpus delicti at what I was doing. But a moment's reflection explained the matter. I had failed completely to sever the fibers of the temporal muscles and as the saw in its to and from movement caught them in its teeth, the muscles would be taut at the extreme ends of the to and fro excursion, but when at the middle of this movement the muscle would be relaxed. The body being absolutely limp from the absence of any rigor mortus, the lower jaw at the middle of its movements would drop only to snap vigorously against the upper jaw when the muscle was made taught again. In a few moments we had sufficiently regained our self command to realize that the man was surely already dead and to continue the post mortem, but it was with unsteady hands and perturbed minds....But it's been years since the scene haunted me and sometimes I plainly hear the sudden champing of the dead man's teeth and never without a shudder.[215]

Keen was clearly a beneficiary of his wartime experience and developed important aspects of his medical identity in this capacity. A case report prepared by him at Satterlee hospital illustrates, for example, the learning and teaching environment among physicians relating to diagnoses, treatment and postmortems. For example: John Shober, then a Private Co. C 14th New York who had been wounded at Malvern Hill during the Peninsula Campaign on July 1, 1862, was admitted to Satterlee hospital July 26, 1862 suffering from "diarrhea as a result of exposure." Keen noted that the patient's diarrhea had rendered him "very prostrate and he was brought to the ward on a stretcher and in almost moribund condition." A "consultation consisting of Drs. Lewis, Hutchinson, Alter, Agnew, and Smith" decided that a free incision should be made, the dead and loose bone removed, a single splint applied with a dressing of lint moistened in a solution of chlorinated soda, and the arm supported in a sling at right angles. Keen noted that there were unpleasant chest symptoms including a hacking cough and pain in the right side. The patient was treated with beef essence, milk punch, quinine and morphia. The case report noted that soon "abscesses formed, the quantity of pus was

[215] Keen Papers, An Autobiographical Sketch by W.W. Keen" B K245 (APS) p. 126.

enormous" and "several pieces of bone were thrown off from time to time." The patient showed a slight improvement until Dec. 15, 1862 at which point he became "very pale and suffers again from diarrhea," and he died Feb 7, 1863.[216] The postmortem was performed by Dr. Leidy in consultation with the physicians that admitted and treated the patient. Leidy noted:

> The case presents several points of interest including the amputation when the patient arrived, the propriety of the exsection when performed, the cause of death and the value of the autopsy in showing the previous disease as well as proving that pyaemia did not occur. Amputation was at once laid aside by unanimous consent and the bodily disease seemed to indicate exsection upon arrival as unnecessary: but one can believe that as soon as the diarrhea and general health became better the bone should have been removed. The propriety of the exsection when performed was beyond a doubt. The cause of death was undoubtedly pneumonia arising from the exposure to the cold. The autopsy renders all clear and is of assistance and value to the surgeon which otherwise would bury his skill and cause failure.[217]

The case illustrates the medical model that developed in response to Circular No.2. Physicians were required to provide a complete case history of the patient for the Surgeon General, which required clinical and postmortem examinations and cooperation in a hospital setting. This was significant for two reasons. First, it allowed physicians to become conversant with hospital medicine in a way that most were not prior to the war. Second, the extensive experience and challenges found in the Civil War hospitals paved the way for the development of newer forms of scientific medicine.

The autopsies were of value because of what they revealed about the cases under investigation, and doctors could now legitimately look for disease and study the effects. Private James M. Loughlin of Wisconsin had been struck in the left hand on May 3, 1863 at Fredricksburg and upon admission to Douglas Hospital May 8 it was noted in his case file that, along with the injury to his left hand, he also had a fracture of the left femur, but with no external wound. It soon became evident that "the knee joint was involved and it was supposed that the femur might have been fissured into the joint."[218] The thigh became swollen and "fluctuated distinctly" and the pus accumulated to such an extent "as to

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[216] RG 94 (NARA) Reports of Diseases and Individual Cases 1841-1893, File A and Bound Manuscripts A-15"Reports of Surgical Cases at Kennedy's, Keen's and Smith."
[217] Ibid.
[218] RG 94 (NARA) Reports of Diseases and Individual Cases 1841-1893, File A, Entry 103 "Specimen Histories, Douglas Hospital" Submitted by Assistant Surgeon William Thompson, June 1863.

disturb the integument from the hip-joint to the foot."[219] Assistant Surgeon Thompson believed the best course of treatment was to "leave the case to nature" feeling that life would "be prolonged a few days." The case file noted that the patient was losing huge amounts of pus, was "desperate, suffering profuse perspiration, dry tongue, rapid and feeble pulse" and he was "muttering, delirious with diarrhea and a faint sickening of the breath" and after "lingering until June 16, he expired."[220] The cause of death was unclear to Thompson and he thus performed a detailed postmortem:

> A number of openings exist through the integument under the surface of the thigh communicating with the abscess. The mystery of the case was however solved and the curious involvement of the joint explained by the discovery of a closed ball wound near the head of the fibula. No attention was ever directed to this. Since I must have closed very early from the pressure of the leg as it was placed posteriously. This ball must have passed near enough to the joint to involve it secondarily. Entering the leg when very strongly flexed and finally striking the femur near the middle and causing a fracture. The bullet was found lying in contact with the femur. Its track was very tortuous and would not give vent to any pus either from the knee joint or the point fracture. This case illustrates very perfectly the mode of death in wounds of the knee joint. The immense abscess in the thigh with some fluctuation in the joint which was confirmed by tracing the track of the ball beneath it on its way to the point of fracture of the femur where the bullet was found. A careful examination and correct diagnosis in the field might have led to an early amputation which may have saved life. This would have been a most questionable procedure at the period when the case was received.[221]

What is particularly interesting about some of the autopsy reports is both the fascination and deeply intimate look at the internal body. It appears that physicians were no longer content merely to examine the body with the naked eye. Many physicians wanted to advance the science of pathology and did so by studying the minute parts of the body in the attempt to understand disease processes. For example, in Satterlee hospital[222] Joseph Leidy performed numerous postmortem examinations and his reports reflect his interest in unfamiliar cases and investigative medicine. Leidy often positioned the practice of the postmortem as a "singular scientific endeavor",[223] and it is not surprising

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[219] Ibid.
[220] Ibid.
[221] Ibid.
[222] Opened June 9, 1862 in honor of Surgeon Satterlee (oldest surgeon on the service at the US at the time) and medical purveyor of New York. Satterlee was a large pavilion hospital and the largest military hospital while in operation and had a capacity of 3,519. For a brief history of the hospital see, Nathaniel West, *History of U.S.A General Hospital, at West Philadelphia, Pa. From Oct. 8, 1862 to October 8, 1863* (Hospital Press, 1863).
[223] Michael Sappol, *A Traffic of Dead Bodies: Anatomy and Embodied Social Identity in Nineteenth-Century America.* (Princeton University Press, New Jersey) p. 53.

that he took advantage of this opportunity to develop scientific medicine. In the year prior to the outbreak of war he suggested that medicine could not acquire the "dignity" of science "until it was based on an acquaintance with anatomy and physiology."[224]He had long been interested in microscopic anatomy and pathology and had studied in Paris with Pierre Louis. In 1861 Leidy was a professor of anatomy at the University of Pennsylvania, but anxiously sought a commission in the war so he could pursue further his interest in the body. For example, in the case numbered 116 in Leidy's case book, Peter Longheran a Private from Philadelphia was diagnosed July 11, 1863 with tetanus[225] due to an injury of the left ulnar nerve from a gunshot wound just below the elbow. Leidy was curious to see whether or not his injury resulted in structural changes in the nerve itself and thus excised and examined the nerves microscopically.[226]Circular No. 2 demanded a new familiarity with the body and it thus became common practice to perform a detailed autopsy and preserve, for further study, specimens of interest. In the case of Private Zach Banbier of the 136th New York Regulars, Leidy studied his body which had been shot twice: in the right hand, which resulted in the loss of two fingers and in the right arm about four inches below the shoulder, which was quickly attacked by gangrene. He analyzed pathological changes, and excised and studied the fluids hoping to delineate the cause of inflammation:

> The ball had struck the bone several inches below the head, but did not fracture it at that point. The head of the bone was found detached from the shaft and the neighboring parts extending downward to the orifice of the ball in the muscles and skin were gangrenous. The upper part of the vein extending with the brachial, was inflamed and contained pus which mingled with the blood, in the rupture of a slight pseudo-membranous or fibronous clot which had confined it. Both lungs were inflamed but especially the lower lobe of the left one, and contained a number of small abscesses. The bowels were distended with air, and were agglutinated by recent soft yellowish, white pseudo-membrane from peritonitis. The cavity of the peritoneum also contained a quantity of thin pus. There were no ulcerations, perforations, or inflammation of the intestines. The latter and the stomach contained a quantity of black fluid like matter, and mucous, a similar fluid to which the patient had vomited. The spleen was large and flabby

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[224] Quoted in Michael Sappol,"The Odd Case of Charles Knowlton: Anatomical Performance, Medical Narrative, and Identity in Antebellum America" *Bulletin of the History of Medicine* 83 (2009) (3): 460-498.Sappol suggests that the "paradigmatic medical science was anatomy, the study of human bodies based on the dissection of cadavers." p. 463.
[225] The Medical and Surgical History of the War shows that there were 509 cases of tetanus among the union forces of which 89% died. See, *The Medical and Surgical History of the Rebellion,* Volume 3, pp. 818-819. Tetanus was a bacterial infection usually caused by animal feces.
[226] RG 94 (NARA) Reports of Diseases and Individual Cases 1841-1893 Entry A-17 Joseph Leidy. "Post Mortem Examinations at Satterlee Hospital."

and contained several large abcesses. The liver except some inflammation and the kidneys appeared healthy.[227]

Leidy preserved the spleen and lungs and sent them to the Army Medical Museum along with his case notes. He probably chose these specimens because of the abscesses, which Woodward also liked to study microscopically.[228]The museum was important in supporting the work of the more experienced American physicians while also supporting the development of the next generation of American physicians. This structure was important for the production and reception of medical knowledge. For example, Leidy noted at the conclusion of most of his autopsy reports what he preserved for the museum, thereby elucidating which specimens were important for showcasing specific diseases and wounds. Henry A. Fellows, Private Co. C 12th N.Y.C. received a gunshot wound of the right fore-arm, "the ball having passed obliquely, breaking the ulna." Leidy noted in his case file:

> The wound was extremely gangrenous; it was filled with a large recent coagulum of bilous from hemorrhage. Organs of the chest healthy. Spleen full size but curiously mottled; in section pale, comparatively bloodless and occupied by a great multitude of apparently of bodies. Mucus membrane of the small intestine, and especially of the ileum were moderately inflamed. The solitary glands large, white and conspicuous. No disease of the brain, but like all other organs it was exceedingly pale and bloodless. I have preserved the bones, forearm and spleen for the museum.[229]

W.W. Keen was similarly able to develop his pathological knowledge during the war. He found the case of Jacob Schlicher age 33 from Massachusetts especially interesting. Schlicher was admitted to Ward No. 2 of Satterlee hospital on July 11, 1863 for a gunshot fracture of the superior maxillary and a wound of the internal maxillary artery that supplies blood to the face. Schlicher had been wounded at the Battle of Gettysburg on July 1, 1863 after being struck by a minie ball, which entered 1 ¾ inches below the left eye and lodged just behind the upper molar partially destroying the left palatine arch, and knocking out the last two molars and portions of the alveolar

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[227] Ibid. Case 123 Zach Banbier, Private Co. K, 136th New York. Prior to the war Leidy conducted research into whether there was bacteria present in the intestine, which he conclusively demonstrated.
[228] Personal Papers of Joseph Woodward, Otis Historical Archives, RG 363 (NMHM).
[229] RG 94 (NARA) Reports of Diseases and Individual Cases 1841-1893 File A Entry No. 17. Post-Mortem Exams at Satterlee USA Hospital Philadelphia, Joseph Leidy, AA Surgeon, USA, Case 136: Henry A. Fellows, Private Co. C 12th N.Y.C.

process.[230]Keen monitored the case closely, often checking on the patient three times daily. He noted that the patient suffered severe hemorrhage upon admission and Keen had trouble arresting it due to the location of the wound. He tried to plug the wound but could not, so he decided, after consulting with his assistant surgeon H. Schell and several of his other colleagues, on a ligation of the common carotid artery. The *Medical and Surgical History of the War* shows that there were only 82 of these procedures performed during the war, with a success rate of 24%.[231]Arterial ligations were difficult (particularly because of the weak surgical background of many American surgeons). Through the war, more surgeons performed these operations out of necessity but it also reflects the developing confidence among surgeons. Keen considered a number of factors before performing the surgery. He noted the efficacy of such surgery because, "the brain would be speedily supplied by the right carotid"; would delay further hemorrhage; and would "control the hemorrhage from the internal maxillary."[232]He noted that the "artery was found without the slightest difficulty" and was tied without injury. His goal was to stop the bleeding immediately; however, while the bleeding was arrested the patient suffered "sudden loss of blood to the brain" for which Keen was prepared. The patient was treated with morphia, beef tea, milk punch, cold water dressings and brandy. Keen monitored the patient twice daily and kept thorough notes on the case. In addition to physical observations such as pulse, temperature, appetite and character of the wound he conducted various tests on the patient's paralyzed side relating to his speech and intellect. The patient died 41 days after the operation prior to falling into an unconscious state. Keen performed the autopsy himself, which was remarkably detailed. He examined the lungs, heart: the walls and valves; the abdomen: liver, gall bladder, pancreas, kidneys; but he reserved his most careful analysis for the brain (which would later become his specialty). He used a microscope as a research tool and looked for the origins of pus and studied the role of inflammation. He cut through the dura matter noting a significant quantity of pus (in the left hemisphere, anterior superior surface, arachnoid cavity) and studied the pus within the cavities of the brain. He studied both sides of the brain and the

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[230] RG 94 (NARA) Reports of Diseases and Individual Cases 1841-1893 File A, Entry 210. Case Report Submitted by W.W. Keen from Satterlee Hospital.

[231] *Medical and Surgical History*, Surgical Section, Vol. 3 P. 762.

[232] RG 94 (NARA) Reports of Diseases and Individual Cases 1841-1893 File A, Entry 210. Case Report Submitted by W.W. Keen from Satterlee Hospital

deposits of lymph that he found. He concluded that the anastomosis or joining of the arteries together "had undoubtedly been imperfect and the supply of blood insufficient in this (left) hemisphere."[233]The next part of his report "Substance of the Brain on Sections" is of particular interest:

> On the right side, in the anterior lobe of the hemisphere, ½ inch from the inner surface of the convolutions, and in the white substance was an abscess, the size of a small nutmeg. On microscopic examination it contents were seen to be undoubted pus, but the cells were ill-formed and irregular in their development of nuclei, under acetic acid. Except this abscess and four small hydratids in the choroid plexus, the entire right side was healthy. On the left side on horizontal section, half an inch deep it presented see figure one: a large abscess or rather a series of small abscesses communicating quite freely with each other, approaching the external surface anteriorly but receding posteriorly: on a section of ¼ inch it presented quite a large abscess immediately anteriorly, and a series resembling the last in the centre, attacking, apparently rather the grey substance and undermining the white which was partly destroyed; the remaining parts being shreddy. On section of about 2 inches it represented a series of unconnected abscesses, eight in number and of various sizes almost totally confined to the external grey matter, the white being shreddy, where it bordered on the abscesses. At the posterior inferior position of the posterior lobe, also were two or three abscesses confined, also almost to the grey substance. In fact, nearly one half of the entire left hemisphere consisted of abscesses. At the point of ligature a few drops of pus were found in a cup shaped cavity and throughout its entire consolidated portion, it appeared dark colored, as if degenerated and ready to slough away speedily....The point at which the hemorrhage had taken place from the internal maxillary could not be found either by inspection or by injecting water into it, since the artery was rendered impervious probably by clotted blood. None of the nerves were injured.[234]

As required by Circular No. 2 Keen prepared and sent the specimen to the Army Medical Museum:

> The specimen has been forwarded to the army medical museum along with the bullet. The specimen in addition to the previous points it will be noticed that the sympathetic nerve has been removed and the descenders noni cut at its middle. This was done in the dissection. A punch like depression exists at the point where the ligature was applied. The opening in the internal maxillary at its origin was made with a view to discover the point at which the hemorrhage had taken place in the antrum but the artery was found impervious to fluids. The left thyroid facial and temporal it will be observed have received some of the injection from the anastomosis with the right. It is also to be observed that a perpendicular cut has been made post-mortem. At the end of the cut made in the second operation, in order to show the antrum better. [235]

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[233] Ibid.
[234] Ibid.
[235] Ibid.

Of interest is the thorough analysis and clear desire to have familiarity with the internal body but also the use of the microscope in the hopes of understanding the role of inflammation, blood vessels and blood, pus, nerve and sense organs and tissues, which supported the development of a medical model which involved the study of diseased structures in the absence of the living patient.[236]Keen was trying to ascertain fundamental alterations in the bodies, tissues and cells through the use of a microscope, and as noted above, he had not even seen a microscope until two years prior to this event. Fascinated with the physical changes in the body, his autopsy reports reveal how the post mortem was used to study and learn from the body.[237]He went onto publish this report in *Hays American Journal of Medical Science* for July 1864, as encouraged by Circular No. 5.

Through the war postmortems became systematic and analytical, and deaths were closely scrutinized. William F. Norris of Douglas Hospital similarly used the cases he encountered to acquire knowledge of pathological-physiology. His case notes are also detail oriented and full of observations; and though he studied the specific cause of death extensively he also studied anatomy and its relationship to function, and like Keen and Leidy, began to think of the role of specific diseases as he looked at the destruction of tissues. In the case of Walter Davis who had received a wound in the left ankle joint at Petersburg, Va., which led to the amputation of his left leg at the lower shin, Norris studied the stump extensively including the arteries, veins, necrosed bone, knee joint, cartilage and muscular space of the thigh; but he also studied the heart, liver, spleen, both kidneys and performed microscopic analyses of the fluid in the knee joint, the patches in the lungs of debris of lung tissue and the tubes of the kidneys (and he studied the urine looking for albumen and casts).[238]He also studied extensively the effects of pyemia,[239]an unfamiliar disease for many Civil War surgeons, and one that became easily recognizable

[236] Using the microscope to examine tissue changes (rather than just the visible changes in organs with the unaided eye) supported the development of cellular pathology first (discussed in chapter 2), and then bacteriology.

[237] He also routinely made woodcuts of photographs of the brain. Letter from JC Dalton to Keen Feb. 22, 1863, in which they discuss this. See, W.W. Keen's correspondence, Library of the College of Physicians, Philadelphia, Box. 1, Ser 1-2. MSS 2/0076-04.

[238]William F. Norris, "Clinical Notes on Cases Seen at the Douglas Hospital at Washington, DC during the late Civil War." Class Z10-70, Library of the College of Physicians, Philadelphia.

[239] Pyemia is an infection that spread into the bloodstream and was referred to during the war as either pyemia or blood poisoning. It was extremely dangerous and had a fatality rate of more than 90%.The disease was easily recognizable and was characterized by red, hot, swollen and very sore skin. In trying to ascertain the cause of the disease, many physicians employed the microscope to understand the role of what we know now was caused by but not limited to bacterial infection.

due to the number of cases and autopsies. For Norris, these cases were of great interest and his reports are often many pages long. For example, Sergeant John Sproul of the New York Volunteers was wounded at Kellys Farm, Virginia November 7, 1863 by a musket ball which caused a compound fracture of the "lower third of the left femur."[240]The thigh had been amputated at its "middle within 12 hours after receipt of injury by Dr. Kimball of the 40th New York Volunteers, double anterior and posterior flap." The patient was diagnosed with pyemia, and it was noted that he was much "blanched and suppuration was free" and he was treated with "milk diet, stimulants, water dressing for the stump, flaps approximated by adhesive strips." His treatment continued for almost three weeks, until he died. Norris first studied the stump in detail:

> There was firm adherence to of the two flaps but no union of the skin. An incision was made in the thigh and the femoral artery and veins carefully dissected not from pouparts ligament or their termination on the stump. They appeared entirely healthy. There were however several icchymous patches on the muscles and in some places near the bone small quantities of pus. The periosteum was thickened and easily separated between it and the bone was in many places small quantities of pus. It had also attached to the osteophyles mostly flattened pieces of bone forming to some extent a casing for the lower end of the femur.[241]

He studied the thorax, the lungs (including dissecting them and microscopically studying the abscesses); the heart and the blood clots and fibrous clots; the spleen, the stomach and the large and small intestine, the kidney, liver and pancreas were also analyzed; and he concluded with a microscopic examination of the "feotid material" found in the femur looking for any aberration in body fluids caused by the disease, which he noted was "decomposing degenerative material; not pus." These investigations were important since they paved the way for pathological chemistry to develop[242] (discussed in chapter 2). In a number of his reports he would remove body parts (e.g. the lungs, heart, larynx etc. and study and dissect them).[243]

There was a keen interest in organs, tissues and the structure of the body, and the order to perform autopsies validated this work as scientific interrogation which could

[240] Clinical Notes on Cases Seen at the Douglas Hospital at Washington DC, Submitted by Walter F. Norris. Library of the College of Physicians, Philadelphia Class Z10-70.
[241] Ibid.
[242] Ibid.
[243] The number and range of cases that he submitted illustrate his desire to master the diseases that ravaged the internal body (both as it related to cause of death and otherwise).

legitimate the extensive analysis of the body or the body as the source of knowledge production. It was common practice to inject the body with arsenic or some other preservative fluid so that it could be studied when time permitted. R.B. Bontecou, for example, found a case "quite fascinating" which he studied at length. Private W.A. Thacker was admitted to hospital number one, Beaufort South Carolina October 24, 1862 after being shot in the right side of the pelvis, "the ball entering at the left side of the coccyx, passing out of the pelvis through the great sciatic notch of the right side, and emerging from the integuments at anterior superior spinous process of ileum on the same side, having apparently traversed the bone at the whole distance."[244] Bontecou began the normal course of treatment, which included wet dressings followed by cerate cloth dressings, a full diet and rest. Things were proceeding well until November 3, when the patient called Bontecou's attention to a "pimple of his left frontal eminence" which was accompanied by "swelling, puffiness, which extended as far as the eyelid." Bontecou noted the appearance was not unlike "that which follows the sting of a bee."[245] He checked on the patient daily and noted that he steadily worsened. Bontecou observed that the "parts in the neighborhood of the pimple have a livid appearance; the swelling had extended to the left side of the neck, involving the face and closing the eye." The patient was treated with "antimony tartas" every three hours, low diet and the poultice was continued. He was later given beef tea, stimulants and anodynes for the pain. The patient continued to worsen: "the swelling has extended to both eye-lids on both side of the face, it has never had the appearance of erysipelas but more like erythema, the skin not red but rather a translucent, edematous look." The patient became steadily more delirious, "quite wild all the time" and "cries out in the night, frequently coughing up sputa stained with blood" and he died 9 days after the pimple had been discovered. The temporal region was distended and "deep seated fluctuation could be detected." Bontecou made an incision down through the temporal muscle to the skull, but only discovered blood and serum (which was likely the bacteria causing infection). After injecting the body with arsenic, in order to preserve it for study, he noted that the gunshot wound had healed (he traced

[244] RG 94 (NARA) Reports of Diseases and Individual Cases 1841-1893 File A, Entry 449, Box 12,"Report of Surgical Cases by R.B. Bontecou."
[245] Ibid.

the passage of the ball), and was content to leave the cause of death as erythema.[246] It was actually an astute diagnosis: erythema is a disorder characterized by redness of the skin and is caused by capillary congestion, which can be set off for example by a gunshot wound that may have caused joint inflammation or trauma. The nodules that Bontecou described as a pimple can indeed occur anywhere there is fat under the skin. The correct treatment is to focus on the underlying cause and in this case he was right to focus on treating the gunshot wound by prescribing bed rest, wet dressings and proper diet.

Postmortems during the Civil War were documented in the attempt to learn from bodies and diseases, and were always descriptive and sometimes analytical. There was for some, a reliance on clinical material (in the attempt to confirm or re-evaluate diagnoses); for others clinical material was not always available and bodies became a prized a research tool, a chance to pursue previously underdeveloped areas such as the analysis of nerves, or the brain or a chance to study the minute parts of the body microscopically. If Bontecou had used the microscope in the above case, for example, he might have been able see a septal panniculitis with acute chronic inflammation of the fat and around the blood vessels. But, Civil War surgeons had not yet been able to make the causal connection between what they saw under the microscope and the diseases under investigation. It was, however, becoming clear to many physicians engaged in this work that the postmortem alone could no longer advance the science of pathology and thus elucidate disease processes. This extensive work with the body raised some fundamental questions about disease: Where is the disease? How can the physician best locate and isolate the disease? What structural changes does the disease incur? The microscope became increasingly important during the Civil War and nowhere was that more clear than in the dynamic and spirited investigations that were precipitated by two of the most fearful diseases encountered: erysipelas and hospital gangrene.

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[246] Ibid.

Chapter Two:
Investigative Medicine during the American Civil War: Erysipelas and Hospital Gangrene

On April 20, 1862 Surgeon General William Hammond issued special instructions to a select group of physicians to investigate the causes, transmission, pathology and treatment for what had become serious problems among the Union Army: erysipelas referred to as "St. Anthony's Fire" or the "Rose"[1]and hospital gangrene commonly referred to as the "typhus of wounds."[2] Hospital gangrene and erysipelas were responsible for significant wartime morbidity and mortality, reported at 45.6 percent[3] and 41 percent[4] respectively.[5]Both are streptococcal infections[6]generally the result of wound infections. According to physician Alfred Bollet, the streptococci that were prevalent during the Civil War "were much more virulent than the strains commonly seen today, and were capable of causing serious infection even without much tissue injury."[7]The bacteria did not attack the skin; the destruction was caused as the bacteria released toxins into the skin and muscles. During the Civil War these were treated as septic diseases because of the destruction of tissue, grotesque wounds and sloughing off of dead flesh. Hospital gangrene was most prevalent in the general hospitals and once it appeared it moved very fast between patients, a consequence of the imperfect understanding of aseptic technique. It spread quickly throughout the body by the blood stream and continued to involve more tissues as the disease spread.[8]As more tissues were destroyed,

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[1] Professor William Pepper, University of Pennsylvania, noted that the word erysipelas meant "to draw near or to approach" which was intended to designate its migratory peculiarities. He also referred to it as St. Anthony's fire to illustrate the inflammation of the skin and redness caused by erysipelas. See, Herbert Marshall Howe Papers, Library of the College of Physicians, Philadelphia 10a/380 from his personal notebook a lecture entitled, "Notes upon the Lectures Delivered by Prof. William Pepper on the Theory and Practice of Medicine, 1863."
[2] Special Order 182, issued by William Hammond April 20, 1862, ordered select physicians to investigate erysipelas, gangrene and pyemia. RG 112 (NARA) Records of the Surgeon General Entry 63 "Central Office Issuances and Forms: Circulars and Circular Letters of the Surgeon General's Office, 1861-1885."
[3] Please see appendix one. *The Medical and Surgical History of the War of the Rebellion*, Surgeon General's Office, Volume 2, Part 3. p. 824.
[4] Please see appendix two. Ibid. p. 854.
[5] The incidence of pyemia is also considered briefly here. Erysipelas can spread beneath the skin, destroying tissues and if the infection spreads to the lymph nodes, it can pass into the blood stream, which was referred to as blood poisoning or pyemia.
[6] Bacteria that appear in clusters resembling a string of beads. Types of this bacteria cause common diseases such as pneumonia. Staphylococcus aureus, may also cause gangrene and often works with strep A. Other aerobic and anaerobic pathogens may be also present, including Bacteroides, Clostridium, Peptostreptococcus, Enterobacteriaceae, Coliforms, Proteus, Pseudomonas, and Klebsiella making the disease very virulent (these pathogens have all been isolated as causes of necrotizing fasciitis or flesh eating disease a modern day equivalent)
[7] Bollet, p. 201. This was due to the fact that there were several organisms working together to produce a particularly deadly infection. As a result of the various organisms the clinical course often varies from patient to patient.
[8] Ibid.

blood clots would form in the small arteries, stopping the flow of blood and nutrients, which was followed by bacterial invasion and putrefaction. There were various types of gangrene reported during the war including traumatic gangrene and hospital gangrene but these cases were studied and recorded together. *The Medical and Surgical History* noted, "According to the conception or predilection of the surgeon, these terms, in many instances, seem to have been used indiscriminately, and it has been found utterly impossible to determine with accuracy the cases of traumatic gangrene, hospital gangrene, dry gangrene, etc."[9]

Erysipelas is an acute superficial form of cellulitis involving the dermal lymphatics (infection under the skin) and is often caused by infection with group A streptococci or group A staphylococcus. It usually needs a break in the skin for the bacteria to gain a foothold. It can stay in one area or spread beneath the skin and like gangrene, aggressively destroys tissues. During the war patients often developed upward spreading "hot, bright red, edematous, infiltrated and a sharp ulcerated tense hard feeling of the cuticle."[10]The symptoms of the disease were "fever, delirium, constipated condition of the bowels, loss of appetite, headache, depression, pulse frequent and full"; and when the disease was "deeper and seated among the cellular tissue these symptoms may be aggravated." It was also noted that the skin looks "smooth and shining but is rough to the touch due to the ulceration of the papilla."[11]It was known that erysipelas involved cellular tissue and could be fatal if it spread to the lymph nodes and bloodstream, which physicians referred to as pyemia.[12]In this case the patient would vomit, which was associated with swelling "due to the effusion of serum into the cellular tissue."[13]Erysipelas generally attacked the legs, torso and face spreading peripherally. These diseases did, however, respond to various treatments and preventative measures

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[9] *Medical and Surgical History* Vol. II, Part III P. 823.
[10] RG 94 (NARA) Medical Officers and Physicians "Medical Officer Files" Box 471, Entry 561. Lavington Quick Papers "Symptoms, Diagnosis, Pathology and Treatment for Erysipelas."
[11] Ibid.
[12] Ibid. See also Herbert Marshall Howe Papers, Library of the College of Physicians, Philadelphia 10a/380 from his personal notebook a lecture entitled, "Notes upon the Lectures Delivered by Prof. William Pepper on the Theory and Practice of Medicine, 1863."
[13] Ibid.

and this result sparked much study and debate among the physicians who encountered the diseases and were charged with their more extensive study.[14]

First encountered as a result of the war, hospital gangrene and erysipelas played an important role in the formation of a new medical model based on scientific principles for American medical practitioners. Although the war years proved to be a stimulus for pre-existing patterns, because of the length and scale of the conflict, these imperatives were refined and developed. Support for the production of newer forms of knowledge in the development of scientific medicine grew in conjunction with this shift. Some physicians realized that the mandates of Circular No. 2, which emphasized the study of disease through the correlation of physical symptoms in the living with pathological lesions in the dead, would not alone provide the answers to these previously unknown diseases.[15]But there was an interesting relation between the concern about gangrene and erysipelas and interest in the study and research of these unfamiliar diseases. Through the case study of both, this chapter will illuminate the state of medical knowledge in the second half of the nineteenth-century and provide a lens into the dynamism of the war as it related to the development of theories of disease and investigative medicine. This chapter is concerned with how disease was investigated, how knowledge was produced and transmitted and the process by which scientific medicine was developed during the Civil War. The scientific medicine stimulated by the investigations into these diseases was very different than scientific medicine today with its controlled experiments in the laboratory. However, these investigations did support the further development of some institutional forms of modern science including clinical trials,[16]tests of the efficacy of specific therapeutics and the study of diseased structures in a physical location away from the patient. The study of hospital gangrene and erysipelas

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[14] It was often noted that when patients developed gangrene in one area, erysipelas would often develop in another area of the body. Patients with these diseases were therefore isolated together and the chapter will thus consider both of these diseases (though since gangrene was more prevalent, more emphasis is given to that disease).

[15] Many physicians had read about these diseases, but had never encountered them first hand. For example, see, "Thesis of Joseph Woodward on Hospital Gangrene" dated May 30, 1861. He comments here on America's lack of familiarity with these diseases. RG 94 (NARA) Medical Records, 1814-1919, "D" File, Box 15 "Thesis of Joseph Woodward on Hospital Gangrene" dated May 30, 1861.

[16] Clinical trials were not the same controlled experiments that exist today in the modern hospital and laboratory setting but we do see some form of this development in which doctors working within the structure of the hospital setting were able to conduct experiments and record the results pertaining to their studies of the body, disease and therapeutics. We see this supported by the new doctor-patient model that emerged in the war. The duration of time the patients stayed in the hospital along with the many patients diagnosed with the same diseases made extensive study and investigation of specific diseases possible/probable.

also proved a stimulus for previously underdeveloped areas in American medicine, including the demand for hygiene and cleanliness in hospitals and medical equipment, consultation about the management of disease, practical demonstrations and experiments and the transmission of this knowledge, which all played an important role in garnering acceptance for scientific medicine in the final third of the century. This chapter will explore how the initiatives to develop investigative medicine through the study of these diseases created a model for the integration of laboratory results and clinical observation. Although results were not confirmed in the laboratory the way they are today; this work paved the way for acceptance of the laboratory approach in medical study by giving shape to the new science and placing value upon scientific medicine as the cornerstone of medical study.[17]

The Laboratory Approach in Medical Study:

Historians of medicine generally agree that between 1870 and 1914 there was a fundamental change in the way in which diseases were understood. By the early twentieth century, organism after organism had been discovered for diseases that had plagued the world for centuries such as tuberculosis, cholera, plague, pneumonia, typhoid as well as the vectors of malaria and yellow fever, which led to new ways of combating disease which included vaccination, public health measures and preventative medicine. The story of medicine in the final third of the century has always been presented as dramatic and exciting with words like "transformation" and "revolution" being commonly used to illustrate the dynamism of these years. The "great men" in the history of disease are always at the center of this narrative. Louis Pasteur, the father of the "germ theory," investigated fermentation and diseases of the silkworm while Casimir Davaine conducted studies on anthrax. Joseph Lister later introduced antiseptic surgery and Robert Koch's work on anthrax, cholera and tuberculosis (and the development of his postulates which gave shape to this new science) encouraged a shift in the way in which disease was understood: there was now a microorganism that could be identified confirming the presence of a disease.[18] It was no longer merely symptom-based medicine; a disease

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[17] In particular, objective observation which was enhanced with experimental method.

[18] This is a three hundred year story and the work of Liebig, Virchow, Pasteur, Koch, Lister etc. make up a very tiny, but significant part of the story. For one of the best syntheses on the history of medicine please see, W.F. Bynum, *Science and the Practice of Medicine in the Nineteenth Century* (Cambridge University Press, Cambridge, 1994).

could exist and be identified even in the absence of a patient.[19] This was initially a difficult concept for some physicians to accept. Proponents of empiricism (often those trained in Paris or its theories) advocated seeing each patient's symptoms rather than subscribing to a theory of disease which suggested that many individuals could be attacked by a single disease form. Not all physicians fully accepted the idea of specificity in disease, which made it a vibrant period of debate and controversy over the direction of medicine. Physicians tried to determine whether disease was a general disorder of the body, or a distinct entity; and if so, how could proof of this be ascertained?[20] What was the role of the environment in relation to the individual? These larger debates, which existed between leading physicians in Britain, Germany and France, were similarly present in America among physicians serving during the war. It was not, however, until the work of Pasteur and Koch became known in America (or encountered in Europe) that some physicians readily accepted the new doctrines. For some acceptance came more readily because of what they had witnessed or studied during the war, particularly in relation to hospital gangrene and erysipelas. In his biography of the southern physician Joseph Jones, the historian James O'Breeden has suggested that,

> He became one of the leading American exponents of the new science of bacteriology after being won over to the "germ theory" when exposed to the work of Pasteur and Koch in 1870 while on a trip to Europe. He promptly recanted his wartime stand [which favored a miasmatic theory of disease], now boasting of having been among the first to see gangrene bacillus and claiming credit for discovering the microorganisms responsible for typhoid fever as well.[21]

Recognizing only the "great men" in the development of laboratory medicine, however, deprives us of a full understanding of the period, particularly in the American context. The record of experience during the war suggests that as physicians encountered

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[19] For the development of the laboratory in medicine see, A. Cunningham and P. Williams (eds.) The *Laboratory Revolution in Medicine* (Cambridge University Press: Cambridge, 1992); W.F. Bynum, *Science and the Practice of Medicine in the Nineteenth Century* (Cambridge University Press, Cambridge, 1994); Gerald L. Geison, *The Private Science of Louis Pasteur* (Princeton University Press, Princeton, 1995); Stanley Joel Reiser, *Medicine and the Reign of Technology* (Cambridge University Press, Cambridge, 1978); T.D. Brock, *Robert Koch: A life in Medicine and Bacteriology* (Madison, Science Tech, 1988)

[20] Tangible proof was not presented until 1883, when Robert Koch conducted a clinical trial among 120 patients with TB. Physicians examined matter coughed up from the lungs and found TB bacilli in all the cases. This proof did much to support the possibility that disease could be combated by using the existence of the microorganisms as the starting point for treatment and/or diagnosis. See, Stanley Joel Reiser, *Medicine and the Reign of Technology* (Cambridge University Press: Cambridge, 1978) p. 88.

[21] See, James O. Breeden, *Joseph Jones, M.D.: Scientist of the Old South* (The University Press of Kentucky: Kentucky, 1975) p. 205.

and studied a broad range of diseases, they began to think differently about disease. As some Civil War physicians engaged in their work with the microscope, for example, they were able to study the manifestation of disease at the cellular level; and it was not until the cellular world was fully observed and experimented with that bacteriology would develop. The historian William Bynum has suggested that by the mid-nineteenth century Rudolph Virchow, the professor of medicine at the University of Berlin who developed the idea that the cell was the primary locus of life and disease, was "among the most intellectually agile" microscopists of the time.[22]Virchow pioneered what came to be known as cellular pathology[23] which essentially suggested that disease could be spread from diseased cells to the rest of the body as cells divided (a process known as mitosis); thus all diseases could be traced as chemical or physical changes within cells.[24] Virchow believed that cellular pathology would transform medicine, particularly through the physiological and pathological study of the body with his theory *od omnis cellula a cellula* (cell genesis); cognizant that all disease processes were ultimately cell processes, he encouraged physicians to begin using the microscope so that they could both think and see microscopically.[25] Virchow placed a primacy on the role of the microscope with the development of cellular pathology (which included analyzing structural change and chemical and physical investigations when considering cellular function), creating a model in which this new specialty could develop.

As Virchow's work was being debated and studied by the scientific community in Europe, his work also gained a few converts in America. One in particular was the curator of the medical section of the Army Medical Museum, Joseph Woodward. Woodward was particularly interested in Virchow's cellular basis of pathology (a summary of which Woodward had translated for the *American Journal of Medical*

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[22] See, W.F. Bynum, *Science and the Practice of Medicine in the Nineteenth Century* (Cambridge University Press, Cambridge, 1994) p. 123.
[23] Virchow's *Cellular Pathology, as Based upon Physiological and Pathological Histology* was not a treatise but rather a record of twenty lecture-demonstrations given by Virchow in February, March and April of 1858 to an audience conversant with the state of medical science at the time, and the focus was on the cells. Other conferences leading up to this one had focused on the tissues and organs—so this singular focus on the cell was not unusual for the time. See, Rudolph Virchow, *Cellular Pathology, as Based upon Physiological and Pathological Histology* Translated by Frank Chance, With a New Introduction by Lelland J. Rather (Dover Publications: New York, 1971) p. vii.
[24] Bynum, pp. 123-124. See also Rather, p. xv.
[25] Rudolph Virchow, "Cells and Cellular Theory" Lecture One, February 10, 1858 in *Cellular Pathology, as Based upon Physiological and Pathological Histology* Translated by Frank Chance, With a New Introduction by Lelland J. Rather (Dover Publications: New York, 1971) pp. 27-50.

Science in April1861.)[26] He was in a unique position during his tenure at the museum, for the first time a significant producer of medical knowledge, but he also had the institutional support to develop both his own medical expertise and that of his colleagues and in his role could legitimately acquaint himself with the leaders in the field. This is evident in his correspondence with Virchow; and contacting Virchow says much about how Woodward envisaged this project. Associating with Virchow was a conscious attempt to enhance the scientific culture of the museum (though it also had the practical effect of creating a framework in which to distinguish between disease processes, to be discussed below). Erwin Ackernect has argued that in the nineteenth-century, "progress in science largely depended on the rise of a new type of scientist... a full time, pure scientist," which developed first within the reformed German universities, particularly because anti-dissection feelings did not interfere with medical research in Germany the way they did in Anglo-Saxon countries.[27]During the war military physicians did not have to deal with anti-dissection feelings[28]and further, with the creation of the Army Medical Museum, there was an institution which could support developing ideas about research and medicine.[29]There was an attempt to move medical study away from the tenets of the Paris Clinical School and toward the German ideology of "pure research" and the laboratory. This was the objective which Woodward articulated to Virchow:

It is not necessary for me to remind you that the eyes of thoughtful men in this country are turned to Germany as the fountain of scientific progress. Allow me also to add that we recognize in yourself as chief of men who in these modern times have succeeded in achieving a real medical breakthrough based upon the inevitable logic of facts.[30]

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[26] J.J. Woodward, Review of "Cellular Pathology" by Rudolph Virchow. *American Journal of the Medical Sciences* (April, 1861): 465.

[27] See, Erwin H. Ackernecht, *A Short History of Medicine* (The Johns Hopkins University Press: Baltimore, 1982): p. 157.

[28] The context of dissections during the war is discussed in chapter four.

[29] The Army Medical Museum was clearly devoted to research, but some hospitals were also equipped with rudimentary laboratories for research, or research was conducted in the autopsy rooms of the hospitals. For example, Lincoln Hospital had an operating room, a cupboard for instruments including a microscope and a "Dead House and Pathological Department" divided into three rooms: bodies, post mortem room in the North, the south end for plaster casts. Operators were employed at $100.00 per month for surgical cases and for the preparation of pathological specimens. See, RG 112 (NARA), Entry 64 "Original and Rough Proof of Circular No. 6: War Department Reports on the Extent and Nature of the Materials Available for the Preparation of a Surgical History of the Rebellion" Surgeon General's Office, Washington Nov. 1, 1865. There is a handwritten report entitled "The organization of Lincoln Hospital."

[30] Woodwards Letter Book, Otis Historical Archives, RG 28(NMHM) Letter from J.J. Woodward to Rudolph Virchow, February 22, 1864.

Significantly he also noted that he appreciated Virchow's *Cellular Pathology* so much so that at his suggestion, "the translation of your book (by Mr. Chance) has been reprinted in this country and distributed as a text book by the Medical Bureau to the surgeons of the medical corps."[31] Woodward went on to suggest that he made "these remarks from no desire to flatter you but because I wish you to understand that your answer to my present communication will be not a personal gratification to myself, but that it cannot fail to exert an influence upon the progress of scientific medicine and especially of pathological-anatomical research in America."[32] Virchow had long encouraged physicians to avoid a purely anatomical approach to pathology and he reminded them that they needed to become pathologists and elucidate pathological processes rather than merely anatomical states.[33] Although by the twentieth-century pathology and pathological anatomy were nearly synonymous in the United States, Woodward encouraged the development of independent investigation related to pathology during the war years, which was important for the development of this research tool. There was not an abandonment of the study of gross lesions, but Woodward did engage in, and encourage the study of alterations in the cells (inflammation or degeneration) and their position in the body.

In his correspondence with Virchow, Woodward described the work at the museum and pointed out that it was the objective of the medical department to "acquire fruits for science." His enthusiasm is evident:

> The innumerable wounds under treatment in our hospitals during the past year have furnished a rich field for collecting surgical materials, and about 2500 specimens have been placed upon the shelves, most of them of great interest, and accompanied by complete case histories, and these specimens are still rapidly accumulating.[34]

Of the medical section Woodward observed: "Medical specimens have been collected in considerable quantities, our difficulty having been less to find objects worthy of preservation, than to obtain funds for the purchase of glass jars of proper quality in sufficient numbers…Though this difficulty will probably be remedied this year by the

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[31] Ibid.
[32] Ibid.
[33] Rudolph Virchow, "Cellular Pathology" Introduction by L.J. Rather, xxi.
[34] Woodwards Letter Book, Otis Historical Archives, RG 28(NMHM) Letter from J.J. Woodward to Rudolph Virchow, February 22, 1864.

liberality of Congress."[35]He sent Virchow copies of some "circulars of general interest" and a copy of his recently published *Outlines of Chief Camp Diseases of the United States Armies as Observed during the Present War* in which his investigations of the minute conditions of the mucous membrane of the intestine in the fever and diarrhea of the troops corresponded with the fundamental doctrines of *Cellular Pathology*.[36]

Woodward's specific reason for writing to Virchow was regarding the microscopial section of the museum, in particular micro-pathological research. Woodward suggested to Virchow that the microscopial department "presented greater difficulties (than the surgical or medical section)[37]and it is chiefly, with regard to that, I have the honor to address you."[38]Stanley Joel Reiser has observed that "Virchow's *Cellular Pathology* provided a theoretical and factual foundation for microscopists, whose instruments became an essential means for studying this ultimate unit of biological activity."[39] It is no surprise that Woodward, in his role as curator of the Army Medical Museum took this opportunity to consult with the expert in his field, particularly since American medical school curricula had so far neglected to provide sufficient courses in which these methods were taught. His communication can be seen as part of the effort to develop this relatively new research tool, which would help to fill the vacuum in America's scientific output. It was a way to assert commitment to scientific medicine by becoming a larger part of the medical network: as someone who could be both a producer and beneficiary of scientific knowledge. It is also significant that he followed the developments in Europe so closely:

In a general way it may be said that the results of the museum are in accord in many respects with the comprehension of the modern Berlin school of pathological anatomy, are contradictory of the doctrine of exudation taught so generally in the older medical text books in use in this country, and at variance also in several particulars with the views of Dr. Lionel Beale, lately so favorably received in England.[40]

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[35] ibid

[36] He offered also to send a few microscopial sketches illustrating these conditions along with an article in German for publication. This illustrates both his status as a producer of scientific knowledge and confidence in his work at the museum.

[37] Which was largely because of the inexperience in this field among American physicians.

[38] Letter from J.J. Woodward to Rudolph Virchow, February 22, 1864. Woodwards Letter Book, Otis Historical Archives, RG 28, (NMHM).

[39] See, Stanley Joel Reiser, *Medicine and the Reign of Technology* (Cambridge University Press, Cambridge, 1978) p.79.

[40] RG 112 (NARA), Entry 64 "Original and Rough Proof of Circular No. 6: War Department Reports on the Extent and Nature of the Materials Available for the Preparation of a Surgical History of the Rebellion" Surgeon General's Office, Washington Nov. 1, 1865. From Woodward's handwritten rough draft, p. 159. What he didn't like about Beale's work

The association with elite Europeans in the development of the museum was an important part of incorporating European scientific medical trends in America. The request for foreign specimens was probably due to the weakness of this specialty in America and the desire to have a basis for comparison. According to Woodward, the microscopial series was started because, "no intelligent efforts to prevent disease can be made without a reasonable comprehension of their nature, and this must rest upon a just knowledge of pathological anatomy."[41] He continued:

> Unfortunately in the United States pathological anatomy is but little studied. The few who pay any attention to the subject confine themselves to such course examinations as can be made with the naked eye alone, or if the microscope is called into requisition its employment is limited to the examination of scraps of torn fragments. The preparation of proper sections, with which only intelligent microscopial researches with tissue metamorphosis can be made is understood by but few physicians in America and practiced by still fewer. Under the circumstance there appeared little probability that an exact study of the pathological anatomy of our camp diseases would be attempted if it were not undertaken in the Army Medical Museum and it became therefore an imperative duty to make an effort in this direction. [42]

He posed a series of questions to Virchow, which give much insight regarding the work being performed at the museum and some of the research objectives of the staff. Woodward was chiefly interested in forming an international scientific community comprised of those engaging in microscopial work related to human normal or pathological conditions which could either be bought or exchanged for specimens being prepared at the museum; he also noted that any donations of specimens to "aid an infant institution" would be much appreciated. From Virchow specifically, Woodward asked for "specimens illustrating the minute anatomy of morbid growths" and advice on preserving specimens along with the most efficacious method of illustrating the minute anatomy of

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was that Beale made errors by "confining his observations on the tissues of his preparations soaked in carmine and mounted in glycerin instead of extending them to the equally careful study of other methods." He may have seen Beale's work first hand. On June 16, 1865 he sent J.W. Queen to England to exchange a section of the scalp and ulcerated intestine prepared with moderate magnifying power. Woodward also asked for "specimens showing the termination of the nerves, the structure of cartilage of connective tissue" and Queen was authorized to "pay whatever he demands within reason." See, Woodward Letterbook 1865. Otis Historical Archives, RG 28, (NMHM) Letter to J.W. Queen, June 16, 1865. Interestingly, Lionel Beale was also a pioneer in the field of microscopy.

[41] RG 112 (NARA), Entry 64 "Original and Rough Proof of Circular No. 6: War Department, Reports on the Extent and Nature of the Materials Available for the Preparation of a Surgical History of the Rebellion" Surgeon General's Office, Washington Nov. 1, 1865. From Woodward's handwritten rough draft, p. 156.

[42] Ibid

the soft parts, both normal and pathological.[43] Woodward noted of the series that, although it was small indeed when contrasted with some of the better European collections, it is the only "considerable micro-pathological collection in the United States."[44] George Otis later remarked to Joseph Barnes about Woodward's work:

Under the direction of Assistant Surgeon Woodward the microscopial cabinet has received large accessories. Additional apparatus has been purchased and the means of investigations in this department are unquestionably of unsurpassed excellence.....for several months assistant Curtis has been engaged in experiments in microphotography and the results already attained have been favorably received by the scientific world.[45]

It was clearly Woodward's attempt to align the Army Medical Museum within the broader spectrum of the emerging research culture that was coming to dominate in Europe. This was a medical system that could be well integrated within the medical context of the war. Research (on a larger scale) was more significant than previously, especially since it now had an important practical dimension in being generated and used at the bedside to treat the soldiers fighting for the preservation of the Union. This new model followed European trends by emphasizing the importance of both clinical medicine and research. It is, however, important to note that physicians working during the war did not make the causal connection between the microorganisms they encountered and the diseases over which they agonized. So was this work of value in garnering acceptance for laboratory medicine? What was its impact in medicine's larger development? Historians agree that the laboratory revolution in medicine depended on a central agent of technology: the microscope.[46] The microscope became increasingly

[43] Letter from J.J. Woodward to Rudolph Virchow, February 22, 1864. Joseph Woodward Letter Book, Otis Historical Archives, RG 28 (NMHM).
[44] RG 112 (NARA), Entry 64 "Original and Rough Proof of Circular No. 6: War Department, Reports on the Extent and Nature of the Materials Available for the Preparation of a Surgical History of the Rebellion" Surgeon General's Office, Washington Nov. 1, 1865. From Woodward's handwritten rough draft, p.157.
[45] Curatorial Records, "Circulars and Reports" Otis Historical Archives RG 6 Box One, Report of George Otis to Joseph Barnes, July 1, 1864. (NMHM).
[46] Audrey B. Davis, *Medicine and Its Technology: An Introduction to the History of Medical Instrumentation* (Greenwood Press, Connecticut, 1981) Russell Maulitz "The Pathological Tradition" in (eds) William Bynum and Roy Porter *Companion Volume of the History of Medicine Volume I*(London: Routledge, 1993) pp. 169-191. See also, Brain Bracegirdle, "The Microscopial Tradition" in (eds) William Bynum and Roy Porter *Companion Volume of the History of Medicine Volume I*(London: Routledge, 1993) pp. 102-119; Erwin Ackerknecht, *A Short History of Medicine*. (Baltimore: Johns Hopkins University Press, 1982); Stanley Joel Reiser, *Medicine and the Reign of Technology* (Cambridge University Press: Cambridge, 1978).

important as an investigative tool during the war. It was used to search for the causal agents of disease in the attempt to elucidate better the diseases under investigation and to arrest them. Although the connection between bacteria and disease was not made during the war, investigative medicine assumed a new importance and was a compelling research method for many medical practitioners.

In particular, Circular No.2 conferred a new scientific commitment and experience for physicians, encouraging the study of the body during autopsy which was routinely examined in light of lesions found in the body, enabling physicians to locate particular diseases in specific organs. (As demonstrated in the last chapter, some experimentalists did use the microscope to examine the pathological changes, abnormal conditions and the minute structure of organs and tissues). But the limitation of localized pathology alone was soon realized, particularly in the investigations into gangrene and erysipelas; this paved the way for the development of newer, more scientific methods to investigate disease, which increasingly emphasized disease in terms of disordered functions as well as altered structures. Hospital gangrene and erysipelas wrought immense damage, but as the experience with these diseases developed, many physicians believed they could be managed particularly through the use of certain remedies. It was noted that, "the disease, like syphilis in its earlier stages, seems to be entirely local and completely curable when the parts affected are not vital organs."[47]Could the quick progress of the diseases then be arrested somehow? Perhaps, soldiers did not need to die from these diseases. But hospital gangrene and erysipelas did raise some fundamental questions. What is disease? What were these diseases? What was the nature of the pus associated with these diseases? How could physicians determine their root cause and thus halt their progress completely? These questions precipitated debate about the best management of these diseases, which interestingly, aided in the development of microscopy (as already noted, a very infant research and diagnostic tool in 1861 America), along with other investigative techniques.[48]

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[47] *The Medical and Surgical History of the War of the Rebellion*, (Surgeon General's Office, Volume 2, Part 3). p. 849.
[48] For more on microscopy in antebellum America see Deborah Jean Warner "The Campaign for Medical Microscopy in Antebellum America" *Bulletin of the History of Medicine*, Volume 69 (1995): 358-383. See also Russell Maulitz "The Pathological Tradition" in (eds) William Bynum and Roy Porter *Companion Volume of the History of Medicine Volume I*(London: Routledge, 1993) pp. 169-191. He suggests that by 1847 only J.S.B. Jackson (Boston) and Alonzo Clark (New York) had begun teaching the "pathological tradition," and were charged with using microscopy to study

In theory all physicians could apply for the right to use a microscope in their investigations; but due to the cost, shipping and their relative scarcity in America, they were primarily restricted to those physicians affiliated with a general hospital or laboratory, those charged with the specific study of the diseases, or those who wanted to contribute something to the development of scientific medicine. Providing microscopes, much like the objective of Circular No. 2, was part of the medical department's attempt to identify medicine with science and provide support for the emerging research culture. It was noted that "applications for microscopes by medical officers in charge of general hospitals will be favorably considered, provided the evidence be satisfactory that the officer will use the instrument for the benefit of science, and will report the results of his observations to the Surgeon-General."[49]In March 1863, Hammond issued a circular letter outlining "information to those surgeons to whom the army microscope is issued,"[50] detailing the conditions upon which the microscope was to be used and maintained. Part of the difficulty for microscopists in this period was effectively "seeing" microscopically, and one of the barriers to acceptance of this specialty was the different results produced by similar investigations. As Reiser has observed, "even devotees of [the microscope] cautioned that its findings must be subjected to rigorous scrutiny, because they were so easily distorted by the imagination. Discordant results from different microscopic investigations of the same subject still engendered distrust to the microscope's accuracy and fidelity."[51]One of the goals for the architects of this project (primarily Hammond and Woodward) was to ensure the best magnification and that the microscopes were well maintained. Hammond's instructions to physicians reveal the high regard in which microscopes were held. He cautioned physicians to keep the microscope "carefully in a

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healthy and diseased structures; however, these positions "were the only full-time American posts in pathology at that time and for awhile to come." p. 180. See also, Brian Bracegirdle, "The Microscopial Tradition" in (eds) William Bynum and Roy Porter *Companion Volume of the History of Medicine Volume 1*(London: Routledge, 1993) pp. 102-119.

[49] RG 112 (NARA) Records of the Surgeon General Entry 63 "Central Office Issuances and Forms: Circulars and Circular Letter of the Surgeon General's Office, 1861-1885. Circular No. 12, October, 20, 1862. "Directions Concerning the Manner of Obtaining and Accounting for Medical and Hospital Supplies for the Army with a Standard Supply Table." p. 114.

[50] RG 112 (NARA) Records of the Surgeon General Entry 63 "Central Office Issuances and Forms: Circulars and Circular Letter of the Surgeon General's Office, 1861-1885. Circular Letter Issued by William Hammond March 23, 1863.

[51] Reiser, p. 79. But also concerns over how specific diseases should be diagnosed and recorded. Please see, Ann La Berge, 'Dichotomy or Integration? Medical Microscopy and the Paris Clinical Tradition," in in Hannaway and La Berge, *Reinterpreting Paris Medicine, 1790-1850* (Atlanta: Rodopi, B.V. Amsterdam, Wellcome Series in the History of Medicine, 1998): 275-312.

dry place, as free from dust as possible" when not in use it should be "locked in a box to protect it from dust, and to prevent it being handled by improper persons."[52]He went onto discuss proper storage, cleaning methods and handling of the microscope, emphasizing that "each objective is to be preserved in its brass case, in manipulating the greatest pains must be taken not to injure or break the apparatus by hasty or inconsiderate movements."[53]Finally, he discussed the best methods for examining blood and urine, which again promoted careful study of the specimens and even more careful handling of the microscope.[54]

Physicians applied enthusiastically for them.[55]Indeed, Woodward, encouraged physicians in the field and hospital to use the microscope in their investigations. He observed at the end of the war that "about two years ago, under my inspiration the Surgeon General's office bought a dozen microscopes, which were distributed to the general hospitals."[56]It was also common during the war for physicians to order microscopes themselves so they could seize the opportunity of increased access to patients, bodies, diseases and hospital work.[57]Some of the elite physicians owned their own, or had had access to them in Paris but essentially a new generation was introduced to microscopy. Audrey Davis has suggested that the use of medical instruments in the nineteenth-century "shaped the approach of the physician to disease and his relationship to the patient."[58]Indeed this directive generated as much excitement among some physicians and proved as important in the development of scientific medicine as Circular

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[52] A phrase that conferred a measure of authority upon those who were issued a microscope.
[53] RG 112 (NARA) Records of the Surgeon General Entry 63 "Central Office Issuances and Forms: Circulars and Circular Letter of the Surgeon General's Office, 1861-1885. Circular Letter Issued by William Hammond March 23, 1863.
[54] These detailed directions suggest that previous access to microscopes was probably very rare. The instrument was clearly highly revered and expensive, suggesting once again the wartime medical environment was an important educational opportunity for those physicians who had never had such access.
[55] During the war, microscopes were employed mostly in clinical observation, with the exception of the Army Medical Museum and a few select researchers who used the microscope primarily as a research tool. See, Joseph Woodward Letter Book, Otis Historical Archives, RG 28 (NMHM) Letter from Woodward to Dr. H. Wintz, Nov. 26, 1865. It was quite common in the 1860s and 1870s to use the microscope to settle diagnostic questions. See, Reiser, p. 80.
[56] Joseph Woodward Letter Book, Otis Historical Archives, RG 28 (NMHM) Woodward to Dr. H. Wintz November 26, 1865.
[57] Benjamin Woodward for example used his own, which was an Oberhauser and he had Roisis on loan, but asked for a new microscope from the government since his were "not as good" as he needed. See RG (94) Medical Records, 1814-1919 D File, Entry 196. Letter to Brinton from Ben Woodward, Jan. 2, 1863. Goldsmith also asked for a new microscope since the one he ordered from Paris had not yet arrived. Ibid. Letter from Goldsmith to Brinton March 8, 1863.
[58] See, Audrey B. Davis, *Medicine and Its Technology: An Introduction to the History of Medical Instrumentation* (Greenwood Press, Connecticut, 1981): p. 7.

No.2. The letters to the Surgeon General's Office illustrate the desire for a microscope by those physicians interested in the development of this investigative tool, and it was common practice to promise the advance of medical science upon the receipt of a microscope:

I take the liberty of making application for the use of a microscope during the time I may be stationed at this hospital. I find it impossible to conduct autopsies and other pathological investigation without one in the thorough manner which is desirable.....If my application be favorably considered, I am prepared to become responsible for the full value of the instrument and its return in good condition at any time that may be designated.[59]

Many physicians were eager to take the opportunity to contribute something of value to scientific medicine, which could also be used to benefit the patients under their care:

I have the honor to respectfully request to be furnished with a microscope for this institution. It will be used entirely for the benefit of science, and any interesting observations will be faithfully reported to you.[60]

The microscope was also used in the hospitals as a teaching tool:

In accordance with directions contained in paragraph 26 of Circular No. 12, I desire to make application to you for a microscope to be used in this hospital. My object in asking for one is solely to apply it to scientific purposes with the view of furnishing interesting and valuable pathological observations which I am enabled to make in this hospital. Such facts as I may gather, with the aid of the microscope, shall be promptly communicated to the Surgeon General. Personally, I am familiar with the use of the instrument, and I wish to give the Assistant Surgeons employed in the establishment an opportunity to familiarize themselves likewise with its use.[61]

The microscope was also a way for physicians to commit to both research and clinical practice:

I have the honor to request that this hospital be furnished with a microscope. Many cases are constantly occurring in which the use of a microscope will not only advance the interests of science but materially benefit the patient enabling a more correct diagnosis to be made.[62]

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[59] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870, Entry 12, Box 65. Letter to William Hammond March 24, 1863 from Elliot Cous, Assistant Surgeon Mount Pleasant Hospital.

[60] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870. Entry 12, box 65. To Hammond from Elias J. Marsh, Judicary Square hospital Washington, DC Jan. 7, 1863.

[61] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870, Entry 12, box 42. To Hammond from Adam Hammer, Assist. Surgeon, US Vols. General Hospital New House of Refuge, Saint Louis, MO. Dec. 30, 1862.

[62] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870. Entry 12.Box 21. To Hammond from C.A. Cowgill, Stanley General Hospital New Berne N. Carolina, June 23, 1863.

Similarly, D.L. Huntington wrote Hammond from the Post Hospital at Fort Monroe, Va. asking for a microscope both to make "microscopial observations of value to science" but also to "throw light upon the diagnoses of obscure cases."[63]The use of the microscope in diagnosis was important in the development of scientific medicine since it changed the way physicians thought about medical practice. This was no longer merely symptom-based medicine. Medical practice changed focus with the use of the microscope. It was now about studying the effects, cause or even the disease itself away from the patient's bedside. It forced physicians to think about the manifestation of diseases in a context other than its end stage or clinical symptoms.

Middleton Goldsmith, who became Superintendent of Hospitals at Louisville, Kentucky in 1863,[64]asked for a microscope which he said was necessary "for carrying out the orders from the Surgeon General in relation to the collection of morbid specimens."[65] Along with his request, Goldsmith outlined his plans for using the instrument, which provides an interesting view of the development of investigative medicine during the war. Prior to being charged with the extensive study of gangrene and erysipelas, in his capacity as Assistant Medical Director in Louisville 1862,[66]he was fascinated with the collection and study of specimens and the diseases that attacked the troops:

> I have the honor to transmit herewith an application for a microscope and also...a statement of the measures I propose to institute...in relation to the collection of morbid specimens. Besides the various questions in regard to gunshot wounds and their treatment, which are not yet answered in surgery, it has seemed to me that it would be well to institute a careful examination into the causes, treatment and morbid anatomy of three principle diseases among the troops in this department and treated in this hospital. These diseases requiring investigation are diarrhea, typhus and typho-malaria fever and pernicious intermittents, including in the first and third dysenteric diseases. I propose to cause careful and full records of cases of each class including all the points worthy of notice and appending to each record the post mortem appearances, each record to be numbered and the morbid specimens numbered in accordance therewith. The object is to compare the results of treatment, fix the value of the diagnostic signs—ascertain the constant as well as varying morbid changes and present for the museum a complete series of specimens illustrating the morbid anatomy of the several diseases....My own

[63] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870. Entry 12, Box 22. To Hammond from D.L. Huntington, Post Hospital Monroe, Va. Feb. 10, 1863.
[64] RG 94 (NARA) Personal Papers of Medical Officers and Physicians "Medical Officer Files" Box. 223, Entry 561. Ordered Superintendent of Hospitals at Louisville, KY. Feb. 1863.
[65] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870. Entry 12, Box 36. Letter to Hammond from Middleton Goldsmith November 4, 1862.
[66] RG 94 (NARA) Personal Papers of Medical Officers and Physicians "Medical Officer Files" Entry 561, Box 223. He was assigned duty as assistant medical director in Louisville Oct. 3, 1862.

microscope has but few of the fixtures necessary for careful original investigation, it being calculated more for such uses as I have been in the habit of applying it for the instruction of my class while giving lectures on surgery in the medical college of this city.[67]

The microscope was used to study minute tissue changes, which could be done extensively with the thousands of specimens from patients suffering from a range of diseases, allowing both comparison of the same disease in different patients and the opportunity to view never before seen diseases. It also enabled physicians to study the different stages of disease, which provided insight into disease processes. The full benefit of the microscope would not be seen until bacteriological investigation became commonplace decades later; but some physicians used the opportunities of the war to become conversant with microscopy, particularly in the investigations related to hospital gangrene and erysipelas. Through the study of these diseases this epistemology became most pronounced.[68]

Many physicians had never encountered these diseases prior to the war. When asked to describe the "peculiarities" in the local disturbance of gangrene in his exam on hospital gangrene Joseph Woodward wrote: "with regard to these, as my own personal experience in civil surgery has never showed me a single case for investigation, I shall be obliged to condense from my recollection of the graphic account of Rokitansky's Handbook of Pathological Anatomy."[69] Much of the American knowledge of the diseases came from the publications of experienced European physicians. Gangrene was often called "the traditional terror of the European armies."[70] In July 1861 the United States Sanitary Commission published documents related to the British experience with hospital gangrene during the Crimean War (1854-56), noting that the disease was "contagious and

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[67] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870. Entry 12, Box 36. Letter to Hammond from Middleton Goldsmith November 4, 1862.

[68] Investigative medicine conferred epistemological authority on the physicians that developed the speciality but it also revealed new ways to see and understand the progress of disease in the body.

[69] RG 94 (NARA) Medical Records, 1814-1919, "D" File, Box 15 "Thesis of Joseph Woodward on Hospital Gangrene" dated May 30, 1861.

[70] RG 94 (NARA) Records of the Adjutants General's Office: Medical Records, 1814-1919 D File, Box 15. "Report in Regard to Hospital Gangrene in the wounded at the Battle of Missionary Ridge Nov. 25, 1863. Submitted to Joseph Barnes from Middleton Goldsmith, in which he refers to gangrene as the "traditional terror of the European armies."The Battle of Missionary Ridge was part of the Chattanooga Campaign and here Ulysses Grant's Union forces defeated Braxton Bragg's Army of Tennessee.

infectious and must be treated in isolation."[71] In 1861 it was common to try to benefit from the example of the Crimean War particularly in managing disease. William Quentin Maxwell has observed that the "Crimea had dramatized the problem of sanitation; the public seemed ready to profit from its experiences."[72]Though British doctors discussed their experiences with gangrene it was only of marginal help due to the relatively few cases presented. In the American case more than 600,000 soldiers lost their lives to wounds and diseases, while just under 21,000 lost their lives in the shorter and smaller Crimean war.[73]

In the American Civil War technology, particularly weaponry was far more deadly.[74] Invented in the late 1840s the conoidal ball (minie ball) used in the minie rifle had been of limited use during the Crimean War; in sharp contrast, it was the central weapon of the Civil War.[75]The minie ball was responsible for the majority of wounds during the war: it easily shattered bones and caused ghastly wounds because the velocity was low and the metal could spread on impact, creating extensive surface wounds (often carrying clothing and other matter into the tissues), leading to numerous amputations and infected wounds. This created almost perfect conditions for gangrene and erysipelas to thrive. The scope of these diseases during the Civil War was immense and unprecedented, but it also presented an opportunity for study. As W.W. Keen observed:

> It has been my fortune during the last four months to witness outbreaks of hospital gangrene. They differed in some points materially from the accounts of the disease as described by Guthrie, Gross, McLeod and Coote, and the older writers on military surgery especially in the rapidity of their progress, and the severity of their symptoms; they were alike in their character, individual treatment and favorable results, but differed from each other widely in the circumstance under which they occurred in their general treatment as to isolation and their tendency to spread.[76]

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[71] Quoted in George Worthington Adams, *Doctors in Blue: The Medical History of the Union Army in the Civil War* (Baton Rouge: Louisiana State University Press, 1952) p. 146.

[72] For the best history on work of the United States Sanitary Commission during the Civil War see, William Quentin Maxwell, *Lincoln's Fifth Wheel: The Political History of the United States Sanitary Commission* (Longmans, Green and Co. New York, 1956). Quoted on p. 6.

[73] Ibid. However, 16, 297 of those were the result of disease, so Americans were cognizant of the importance of creating a structure which could treat, manage and combat the ravages of disease.

[74] See, James McPherson, *Battle Cry Freedom* (Oxford University Press, New York, 1988): pp. 474-475.

[75] *Medical and Surgical History of the Rebellion*, Surgical Section, Vol. 3, p. 696 estimates there were 108, 049 or 76% of wounds which were caused by the minie ball

[76] RG 94 (NARA) Reports on Diseases and Individual Cases, 1841-93 File A, Entry 265 Report Submitted by W.W. Keen, USA General Hospital West Philadelphia, Ward 2 "Clinical Observations on Hospital Gangrene, 1862."

Middleton Goldsmith similarly recalled that the "opportunities presented in the military hospitals of this city (Louisville, KY) for the study of these diseases have been great."[77]

Disease Theories during the Civil War:

By 1862, as the general hospitals became increasingly full with wartime convalescents, gangrene and erysipelas posed serious problems to the health of the troops. Goldsmith (acting on the orders of Hammond) issued a circular letter on March 14, 1862 in regard to hospital gangrene and erysipelas requesting that physicians submit reports based on their researches and experiences with these diseases:[78]

> A series of observations on this disease is most desirable in the present state of the science, and to the end that they may be fruitful of useful results they should be independent of traditional views and opinions—each observer should study the disease for himself as if he were observing a new disease, faithfully portraying the facts and appearances as they occur so that those reading his descriptions could see the cases as he saw them. When opinions or conclusions are expressed the facts upon which they are based should be clearly set forth.[79]

The circular asked physicians to pursue investigations into the causes, transmission, pathology and treatment for erysipelas and hospital gangrene. The answers to these questions were the focus of the hundreds of case reports submitted on these diseases. In particular, Goldsmith was aiming to determine if these diseases were "internal diseases" caused by a general disorder of function or developed *de novo*. Or, did they, as Virchow's cellular pathology suggested, develop in the body from a malfunction of existing cells? Either explanation favored a physiological conception of disease. Or lastly, did an external agent enter the body to produce the disease, which would support an ontological conception of disease. Goldsmith also asked physicians to consider "reference to a previous condition" the "solidity" of the tissues in considering the spread, the nature of the pus in the sores (both as it progressed or was arrested), and the role of putrefaction and decomposition. He also asked physicians to consider all constitutional disturbances related to gangrene. [80] His aim was to compile a picture of the disease: when particular symptoms would occur and in what stages of gangrene, including how the sore changed

[77] Middleton Goldsmith, "A Report on Hospital Gangrene, Erysipelas and Pyeamia as Observed in the Departments of Ohio and the Cumberland with Cases Appended" (Louisville, Bradley and Gilbert, 1863) p. 3.
[78] RG 94 (NARA) Medical Records, 1814-1919 D File, Entry 250. "Circular Letter in Regard to Hospital Gangrene," March 14, 1862.
[79] Ibid. It was common to profit from European medical experiences but the war also encouraged physicians to engage in independent observation and research—to produce new forms of medical knowledge about disease.
[80] Ibid.

in each particular stage. Finally Goldsmith requested physicians to suggest remedies to arrest the "gangrenous process," how to produce and maintain the "granulation," how to treat the constitutional disorder and lastly, and how to best treat the slough "when they have lost their poisonous quality."[81] The case reports reveal a variety of ideas about disease and also that physicians wrestled with a number of concepts regarding them: Were they living? Or were they chemical? And, where did they come from? Were they the result of miasmas, chemical septic products? Was a zyme introduced? A specific contagion? Or were they infections arising internally? Did a disease poison arise spontaneously? Did the disease rest in the blood? Was there a malfunctioning of existing cells in the body? Were there disease cells in the atmosphere? Physicians did not have a clear idea of what they were looking for or what they might find, and there were a multitude of approaches for investigation. But the chief debate centered on whether or not these diseases were "local affections" or had "constitutional origins."

Physicians were challenged by the changing disease theories of this period simply by what they were studying during the war. The case reports relating to these diseases reveal both dynamism and complexity. Similar to the way in which the study of specimens challenged individualized holistic ideas of disease causation by placing emphasis on the lesions found in the tissues and organs, the study of gangrene and erysipelas made physicians question once again the nature of disease. Importantly, however, physicians had numerous cases to study in the hospitals, government and collegial support for research and experimentation and even new equipment to study these diseases. In considering how disease was understood by Civil War physicians an examination of Joseph Woodward's *Outlines of Chief Camp Diseases* is revealing. He employs the same classification as the British Army in 1859 and 1860 which broke up the "zymotic theory" (decomposition or degeneration) into four groups of disease ferments: miasmatic (from air or water, soil and plant matter), enthetic or contagious (person to person or result of inoculation), dietic (related to constitution). He also mentions parasitic diseases (intestinal parasites and scabies) but he suggests that they must stand in their own class: *Parasitici*—since parasitic diseases were no longer seen as a constitutional

81 Ibid.

affection but rather an animal infecting the skin and intestines.[82] Some case reports refer to the diseases as septic ferments (meaning to rot) because of the massive destruction of tissues.[83]Interestingly, physicians who were wedded to one cause of disease may have found their views challenged during their investigations into hospital gangrene and erysipelas. For example, those committed to the idea that disease was the result of rotting vegetable matter or "noxious effluvia" in the environment and depended on vulnerable constitutions may have had to concede that there was some sort of specific contagion involved. There was, however, no clear cut line. The case reports reveal the diversity and broad range of ideas related to disease, but also the conflicting ideas between physicians and even within a physician himself.

There were four general theories advanced in accounting for the appearance of erysipelas and gangrene: constitutional, local or local and constitutional, or a malfunctioning of existing cells. The constitutional cause held that a debilitated constitution as a result of exposure, poor diet, fatigue, impure water along with a poison in the air or "miasmatic atmosphere"[84]might lead to gangrene. Others believed in local causes: that it could be transmitted through direct contact with gangrenous matter such as sponges, wash bowls or surgical instruments, especially in crowded, poorly ventilated conditions. Some believed they had both local and constitutional causes. Finally some adherents of Rudolf Virchow's recently published lectures on cellular pathology believed disease was spread from diseased cells to the rest of the body as cells divided and thus all changes could be traced as chemical or physical changes within cells. Perhaps most interesting, Goldsmith advanced the idea that erysipelas most often resulted "in the form of puerperal peritonitis from the infection upon the hands of the midwife, as in the

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[82] Joseph Woodward, *Outlines of the Chief Camp Diseases of the United States Armies: As Observed During the Present War.* (Lippincott, Philadelphia, 1863). pp. 13-27. The classification "zymotic" was introduced by William Farr in the 1840s (though he drew on Justus Von Liebig's chemical theories of disease) and the label covered most infectious and contagious diseases. Disease was thought to be caused by some organic particle that was ingested, and when combined with the internal body started a process of decay. These ideas would lay the foundation for bacteriology to develop. Especially the idea that "small entities of life" could cause disease. See, John Waller, *The Discovery of the Germ: Twenty Years that Transformed the Way We Think about Disease* (New York: Columbia University Press, 2002) pp. 55-57.
[83] Physicians did not specifically distinguish between septic and zymotic diseases.
[84] This "ambiguous" term encompassed both the idea that poisons could come from another person or from the environment. See Michael Worboys, *Spreading Germs: Disease Theories and Medical Practice in Britain, 1865-1900.* (Cambridge University Press, Cambridge, 2000) p. 38.

historical German cases."[85]He suggested that the "artificial production of erysipelas may be summed up in the agency of putrefying animal matter."[86]But Goldsmith's thinking on the matter was complex and well outlines the uncertainty about causation. Differing disease theories such as contagion (person to person) or infection (indirect contact through water, air or contaminated articles) or miasma (associated with putrid odors)[87] were both interchangeable and complimentary for Goldsmith and indeed many physicians. For example, he suggested that erysipelas was contracted from the "putrid odor" emanating from the bodies of the sick[88]and a precise relation between putrefactive processes in the development of erysipelas (the result perhaps of chemical agents that caused organic material to decompose in the body), suggesting continuity between the body and the environment.[89]In terms of gangrene, he proposed that it was produced by inoculation, that the "poison" spread through the "medium of the atmosphere and adheres with great endurance and tenacity to fomites, which spread through multiplication of gangrenous matter."[90] The question was: were these agents living or chemical?

The record of work that resulted from gangrene and erysipelas gives excellent insight into the period because of their specific pathology. In trying to determine the nature of these diseases, physicians were asked to think hard about what certain manifestations meant, including the pathological changes, degenerative changes, the role of inflammation, the nature of the pus,[91]decomposition, all of which demanded reflection about the fundamental nature of disease. The long contest between proponents of the miasmatic theory of disease and contagionists is highlighted through the study of gangrene and erysipelas.[92] The case reports reveal that there was almost overwhelming

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[85] Goldsmith, p. 6. The Vienna physician Ignac Semmelweis advocated washing hands in chlorine to prevent the spread of puerperal sepsis in obstetric cases. It was first published in the 1860s suggesting that Goldsmith was on the "cutting edge" of medical science.
[86] Ibid.
[87] For more on the historical development of disease theories see, Margaret Pelling, "Contagion, Germ Theory, Specificity" in (eds) William Bynum and Roy Porter *Companion Volume of the History of Medicine Volume 1*(London: Routledge, 1993) pp. 309-334.
[88] Goldsmith, p. 6.
[89] He also advanced the idea that there could be some kind catalysis in the body which he believed to be lactic acid in the blood.
[90] Ibid. p. 7.
[91] Laudable pus meant the quality of pus, for example "yellow color, creamy and inodorus" versus infected or ichorous pus which smelt foul, and was thinner and blood tinged, which usually preceded death. See, Alfred Bollet *Civil War Medicine: Challenges and Triumphs* (Galen Press: Arizona, 2002) p. 200.
[92] For the best study on disease theories and anticontagionsim see, Erwin Ackerknect, "Anticontagionism between 1821-1867" *Bulletin of the History of Medicine*, 22 (1948): 562-93.

support for contagionism. But it is significant that allopathic physicians were debating causation, treatment, and the nature of disease. Prior to the war, thinking about medicine generally, debates often centered on its direction and highlighted in the struggle between allopathic medicine and alternative sects; it was a constant challenge for allopaths to pursue their agenda. During the war, physicians had a new intellectual environment in which to debate not the value of scientific medicine, which was generally agreed upon, but rather how to apply it (treatment, diagnosis, reporting) with efficacy. In the broadest sense, this was a significant evolution in American medicine.[93]

The case reports reveal that the approach to these diseases in terms of investigation, understanding and treatment were highly individualistic endeavors, which has left an interesting record of work. There were three ways that physicians produced knowledge. Some adopted the traditional empirical observation of the diseases (amassing information which was to be synthesized by the experts charged with the study of these diseases), others analyzed the diseases, patients, hospitals and locales, trying to prove or disprove commonly held notions about the diseases, while still others went one step further and adopted new techniques such as chemical, microscopial, animal and even human experimentation, adumbrating the importance of the laboratory for producing medical knowledge. The common thread was that most physicians were simultaneously intrigued and shocked by these diseases which were unsightly and spread quickly within and between patients. As Keen remarked, the disease was marked by its "disgusting symptoms" and "offensive odor."[94]Silas Weir Mitchell similarly observed:

> There were some horrible things seen in the surgical wards many I trust we'll never see again only in jar in the surgeon general's museum. A slight flesh wound began suddenly to show a gray edge of slough and within two hours we saw this widening at the rate of half an inch an hour deepening, until some horrible cases of arteries and nerves were left bare across a devastated region. It was what we called hospital gangrene. Instant removal to the open air of tents, etherization, savage cautery with pure nitric acid or bromine, and dressings of powdered charcoal enabled us to deal with these cases more or less well, but the mortality was hideous—at least 45%.[95]

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[93] It was indisputably an important period in the development of the orthodox physician. They were exposed to new diseases, given resources to investigate these diseases, and above all the opportunity to practice. It was in many ways a triumph for the allopaths.

[94] RG 94 (NARA) Reports of Diseases and Individual Cases, File A, Entry 265. Report Submitted by W.W. Keen, USA General Hospital West Philadelphia, Ward 2 "Clinical Observations on Hospital Gangrene, 1862."

[95] Silas Weir Mitchell, "The Medical Department in the Civil War: Address before the Physicians Club" Chicago, Illinois 1902/March/25. Library of the College of Physicians, Philadelphia, Box 17, Series 7.

Managing these diseases was considered a challenge and contributing to the general understanding of these diseases legitimized the physician's role as producer of scientific knowledge. As Keen remarked, "hospital gangrene or the "typhus of wounds" is in its most marked form, a fearful and unwelcome guest in any hospital; most of all in a military hospital. It claims many victims in its fierce attacks, and often puts to naught all the resources of the most skillful surgeon."[96]With the opportunity of a hospital post Keen was able to offer some important insights regarding gangrene:

> The question has almost uniformly been raised by authors whether the disease is constitutional or local. Without quoting particular authorities, suffice it to say that rather the larger number regards it as a local disease. "Sometimes" in the language of Guthrie, preceded by and accompanied with, constitutional symptoms. But the concurrent constitutional symptoms are no proof of a similar character in the disease, for the removal of a benign tumor. An amputation, or a gunshot wound is followed by the same. No one as yet has ever seen the disease <u>originate</u> constitutionally, but <u>always</u> locally....Even when the constitutional symptoms are present, as I have seen the disease, they have been very slight and rarely exceeded anorexia, sleeplessness and a slight irritative fever. Of the 50 cases in Frederick, I have statistics of 25. In these, constitutional symptoms preceded the disease in but 5 cases, accompanied it in 4 leaving, 16 unaffected constitutionally. Of the 19 cases here seen, there were two in which they preceded, and 4 which they accompanied the disease, leaving 13 with no constitutional disturbance.[97]

With the benefit of many cases, Keen was able to support his views based on extensive clinical observation:

> I have often seen it attack a wound or exit and leave the other free; I have seen it attack an abrasion over the head of the fibula and leave untouched a compound fracture of the same thigh; attack an ulcer on a leg, and pass by the granulating stump, 3 inches lower down. I have yet to learn of a single case occurring among patients in the field: a fact fully corroborated by other surgeons who have had greater opportunities in the field than myself, and which I can only explain by the reason that the patients are usually placed in houses, or in the field itself where free ventilation is attained.[98]

The debate about local vs. constitutional origins of the disease was important to physicians because it helped answer questions about causation. For example, did the disease rest in the body, or was there a specific contagion that traveled on fingers, sponges etc. which was obtained externally? Could a "germ" cause an internal disease?

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[96] RG 94 (NARA) Reports of Diseases and Individual Cases File A, Entry 265 Report Submitted by W.W. Keen, USA General Hospital West Philadelphia, Ward 2 "Clinical Observations on Hospital Gangrene, 1862."
[97] RG 94 (NARA) Reports of Diseases and Individual Cases File A, Entry 265 Report Submitted by W.W. Keen, USA General Hospital West Philadelphia, Ward 2 "Clinical Observations on Hospital Gangrene, 1862."
[98] Ibid.

Daniel Morgan, assistant surgeon at the U.S General Hospital in Indiana, undertook an in-depth study of hospital gangrene and erysipelas in late 1862 and submitted his report to Hammond:

> Preceding Oct. 19, 1862 three or four days of cold rainy weather set in, which occasioned the closing of the doors and windows to keep the men dry. On the 2nd or 3rd day I saw three cases of decided gangrene all in the lower extremity, about 12 or 15 wounds also which had been progressing fine, stopped cicatrizing, and assumed an unhealthy appearance. They were red and punctuated in some small new vessels and they bled freely. On removing the dressing the parts already cicatrized became bluish, red and in the worst looking cases an inflammatory nature—red color with a hard base, was observed.[99]

Morgan removed the cases of gangrene "to a tent with 6 beds and an allowance of space of 232 cut feet, where under treatment, they rapidly recovered." He noted that the beds and tent were "carefully ventilated." He reported that the "weather became fine and in two days the unhealthy sorts recovered their original healthy appearance and no more cases occurred."[100] Matters in the hospital progressed well until November 8 when the disease reappeared:

> During the last an attempt was made to treat the cases in the ward without isolation, but it only ended in an utter failure and they were again removed. Four days before it made an appearance in barrack E the disease appeared in barrack B where its history was an exact counterpart to the one already related. From these two barracks the most over crowded, and by the way the only one in which erysipelas had appeared, the disease spread to all the others in most cases apparently by contagion and some clearly by infection. Through the careful use of sponges, and yet strange as it may seem, but one case appeared among the patients in the tent. They were, it is true, far lighter cases of wounds but they were apparently much more exposed by the small allowance of space, and by their greater proximity to the gangrene tent. Two cases proved fatal by reason it seems of other organic complications.[101]

His report well outlines the complexity and overlapping theories of disease during the nineteenth century. Was there a miasmatic poison causing organic complications? Or rather, did the infection caused by the wound seep back into the body? Or was there a specific contagion that resulted from or caused the morbid processes? Perhaps a different locale would produce different results. Morgan left his post in Indiana and reported for

[99] RG 94 (NARA) Reports of Diseases and Individual Cases, File A, Entry 269 Box 5. Daniel Morgan, Assistant Surgeon USA General Hospital Indiana "Surgical Report of Hospital and Surgical Cases."
[100] Ibid.
[101] Ibid.

duty to the West Philadelphia hospital where he continued to study the incidence of gangrene and erysipelas. His first report enumerated a local cause of gangrene:

> Dec. 23 1862, 50 new patients were admitted to ward 1 and 100 each to wards no. 2 and 3. Of these 25 in ward one, 80 in ward two and 15 in ward 3, 120 in all were gunshot wounds. There were at the same time 2384 patients in the hospital of whom rather more than 200 were wounded. The allowances of space in these three wards, which are contagious is nearly 1200 cub ft. to each man. But few of these new wounds were discharging freely, and scarcely any were more than flesh wounds of no great severity. One week after admission Dec. 30th 1862, I observed the cases of decided hospital gangrene, both of the thigh, in my own ward; and at the same time 8 of 10 of the other wounds began to look unhealthy. The cases of decided gangrene were immediately vigorously treated by nitric acid but were not removed from the ward and the fullest precautionary measures were taken to prevent the further progress of the disease. Since the patients could not be removed, I resolved to put the ward in as favorable a condition as possible. I ordered every other window on both sides to be lowered both day and night and put a reliable patient in charge of the matter. I obtained a sponge for each man; directed the nurses to dress the gangrenous and unhealthy sores and to wash their hands carefully in dilute chlorinated solution and to use no dressing or bandage a second time and soda freely used on the floor near those suffering from the disease.[102]

He compared what he had seen in Frederick and West Philadelphia to try to ascertain the causes of the disease:

> A marked contrast is thus seen to have existed between the disease as seen at Frederick and at West Philadelphia. At Fredrick it was noticeably contagious and spread widely and to every barrack; in West Philadelphia, although probably contagious it did not invade many wounds in the same wards nor did it spread mostly to adjoining wards, there the patients were isolated, here they were retained in the wards, there all attempts to treat them successfully in the barracks failed; here it has been perfectly successful; there nitric acid was used as an escharotic; here both that and the acid nitrate of mercury. It should be noted that both attacks followed a few days of bleak, cold and rainy weather: that both occurred where a number of wounded were collected together: that in individual symptoms both were precisely alike, and that they improved immediately on the setting of fine weather and under appropriate treatment; that simultaneously with outbreaks of the disease a number of wounds assumed an unhealthy appearance, but quickly improved under proper hygiene treatment and good weather.[103]

He evolved a concept of contagion and suggested the reality of a disease entity and a constancy of the disease from patient to patient; however, he also included older ideas related to miasma. Morgan subscribed to the view that the disease was local and constitutional, that patients needed to be in some kind of debilitated state along with local

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[102] Ibid.
[103] Ibid.

factors (atmospheric contamination or contact with gangrenous matter). But what he proposed was a more scientific interpretation than merely a simple theory of toxic miasmas in filthy surroundings. Most significantly, he emphasized the importance of antiseptics in the hospital setting; that the surgeon had a responsibility to manage gangrenous wounds before they became septic, which had immediate clinical relevance in the management of these diseases. He did not explicitly suggest the idea that the disease was caused by a specific germ but there was clearly some agency in the process of the disease.

The prevalence of gangrene gave physicians a chance to monitor continually the course of a disease and the manner in which physicians studied disease reveals differing and shifting scientific styles. In John Brinton's papers is a small note book entitled "Hospital Gangrene, Annapolis General Hospital" containing notes and illustrations of cases that he encountered in the field.[104] He made extensive observations about gangrene and a number of drawings of limbs illustrating the effect of the disease. He kept track of many of the patients he encountered and chronicled the progress or decline of the disease. He often remarked about the gruesomeness but the disease clearly excited his interest and he looked for opportunities to study it further. He examined the character of the ulcer, the surrounding integument, the undermining edges, the appearances of the stump, nature of the hemorrhage, the appearance of the limb and he questioned the patients about the character of the pain, and recorded all the constitutional symptoms. He took into account the hospital and atmosphere and tried to ascertain whether the disease preceded or followed local symptoms.[105]Patients presented pronounced clinical symptoms, which proved of interest due to their graphic nature and unfamiliarity; however, scientifically-minded physicians also used the investigation into these diseases to incorporate new ideas about research and investigative medicine. Brinton's published report was to be of benefit to the Union and later to be of practical use to physicians. While he adopted the more traditional empirical observation of disease, his publications were evaluated along with the laboratory investigations, which provides a good example of laboratory and clinical medicine being complementary and reciprocal during these investigations.

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[104] RG 94 (NARA) John Brinton's Manuscripts, 1861-1865. Box One, Entry 628, Entry A-No. 239.
[105] Ibid.

Some physicians chose to focus primarily on the effects, cause and process of disease, which represented a shift or at least overlap towards physiology and experimental biology in investigating disease. Specific manifestations such as the "disorganization of the tissue, the "vibrios," "globules," "animalcules" or "cells" were now studied at length. For example, on February 18, 1863 Brinton's co-worker, Joseph Woodward was dispatched to the Annapolis General Hospital "for the purpose of examining the microscopial appearances of hospital gangrene."[106]His chief objective was to determine how and why the disease spread with such rapidity. He made some clinical observations in his report but confined himself mostly to pathological histological considerations. He found two "diverse modes of extension" of the disease while in its destructive progress," which he found frequently combined in "different portions of the same excavation." He was referring to the spread of the disease and the damage to the tissues (which involved the connective tissues and adipose layer). Physicians would often examine the first point of the disease, which was usually the point of entrance and exit of the wound, but it quickly spread to the tissues where the most damage would be wrought. Woodward examined the tissues immediately adjacent to the slough and noticed that they became slightly reddened without being increased in thickness and had a tendency to become greenish brown or black (as tissues were destroyed); the slough steadily progressed into the sound tissues "so long as it is not separated" and continued to extend by a "pus producing or ulcerative action." The second class of the disease he examined was the slough invading the surrounding tissues deeper because the "thickened mass breaks down rapidly into a fetid yellowish ichor (signaling infection) and is quickly eroded in such a manner as that the subcutaneous connective tissue is more speedily destroyed than the skin which overhangs."[107]This variety was more serious, causing more tissue damage since it penetrated the "deep fascia," the "connective tissue septa" and even the muscles and tendons producing inflammation and often times, sepsis.

Woodward accommodated the disease processes to cellular pathology. His methodology was to examine both "modes of extension" to try to determine both how to

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[106] RG 94 (NARA) Reports of Diseases and Individual Cases File A Entry 295 "Report on the Microscopial Appearance of Hospital Gangrene in the Annapolis General Hospital" Feb. 19, 1863 by J.J. Woodward for the Surgeon General.

[107] Ibid.

arrest the spread and understand the pathology of gangrene, in particular to determine at what stage the disease became septic and what changes could be observed along the way. His investigations illustrate how he saw the disease process, which was that gangrene was the result of degenerative and inflammatory action due to diseased tissues and cells. In the first variety of the diseases he saw, he examined the slough as close as possible to the living tissues but found nothing but the normal "elements of the affected part in various stages or putrefactive decomposition." Because decomposition had already begun he proceeded to investigate the "sloughs of this character from the living tissues" (which were now at risk). He found that "none of the lymph or pus forms which usually result from inflammatory action could be observed" and the "small vessels and capillaries of the living tissue near the slough were gorged with blood which in the vessels immediately adjacent to the dead parts was completely stagnant." He examined the living tissues through the slough to the central cavity exposed by the disease and discovered that the "elementary forms were found to be more and more completely obscured by the putrefaction change until a granular opaque mass remained"; in it no other elements could be observed save a "few yellow elastic fibers which had resisted decomposition" but which left some pus. He found in the first set of cases that "while the disease continued to spread peripherally a line of demarcation was formed by a true ulcerative action with pus formation between the superficial slough and the subjacent muscles, the pus being formed in at least some of the cases at the expense of the muscular tissue."[108]

The second strain of gangrene that he examined was found to have "thickened and hardened edges into which the eroding process was extending and showed the tissues to be transformed into a mass of cell forms of which the most numerous were spherical granular cells, quite identical in individual aspect to ordinary pus corpuscles but embedded in a granular mass and thus constituting what has been variously called corpuscular lymph." He also found in the same mass "connective tissue cells in various stages of enlargement and multiplication by division" in which he found "free-forming out of the ichorus pus."[109]He defined the process in this variety as occurring in two stages:

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[108] Ibid.
[109] Like Virchow, Woodward believed that inflammatory pus cells originated from other cells.

In the first there is an external rapid cell multiplication resulting in the formation of innumerable cells of croupous lymph with which the tissues are crammed. In the second, the death of the infracted tissues, either gradation as an eroding ulcer, or in mass as a bulky slough.[110]

He believed the morbid changes were being spread from cell to cell and found these cases to be a good opportunity to study the "pus formation in the muscular tissue" and the role of the "muscular fibre" in the inflammatory process. He believed the "so called nuclei of the sarcolemma" contributed to the formation of the products of inflammation by enlarging, multiplying and producing "broods which encroach upon the proper substance of the fibre." He considered that the pathogenic process causing inflammation had to be countered. When it was not, the wound took far longer to heal, or it would steadily worsen, leading to sepsis. Woodward thus recommended local treatments, combined with treating the debilitated state, hoping to strengthen the patient from within and counter the poisons. One of the ways he measured the "debility" of the patient along with the state of inflammation caused by the disease was by studying the blood:

In all it was observed that a needle inserted into the finger to obtain a drop of blood for examination required to be carried deeper than usual to obtain it. The blood thus obtained presented in every case a noticeable increase in the proportional number of white blood corpuscles which were also as a rule larger than normal (1/2800 to 1/2500 of an inch in diameter). This condition was developed in some cases much more than in others but in none attained to an exquisite degree the usual appearance of the field obtained by pressing a drop between thin glass being shown in figure four. The red blood corpuscles were scanty, pale, and showed less tendency than in healthy blood.[111]

As part of his attempt to understand the cause of inflammation or the origin of pus he studied the blood looking for any changes that might precede tissue changes. He noticed the increase in white corpuscles but did not know why this action contributed to inflammation.

Like many other cell theorists he was opposed to any idea of an invading germ. Thus even when he saw the bacteria clearly he failed to identify correctly their role in the disease:

An allusion may be made to the idea that the peculiar characteristics of this disease are due to the local presence of microscopial fungi. This idea is not borne out by facts. Accurate examination with a magnifying power of cases in every stage both where

[110] Ibid.
[111] Ibid.

> nothing but an ordinary water dressing had been employed as well as in cases in which various forms of antiseptic caustic washes had been applied utterly failed to demonstrate any cryptogrammic organisms except the ordinary bacteria which are to be observed in every decomposing animal substance.[112]

While his investigations did not lead to the discovery of the streptococci causing gangrene, his methodology was important. He studied the "putrescent matter" in absence of the patients; he studied their blood ("scanty" red corpuscles and the increases in white corpuscles) trying to determine the internal manifestation of the disease and most importantly, he studied sequences of the disease process (in the two stages he saw); and he published his findings including diagrams of his microscopic results and blood analysis. To illustrate the role of inflammation, diseased tissues and cells as the disease progressed, it was mandatory to use a microscope. Much of his work was important in laying a foundation on which to investigate diseases, ultimately helping to pave the way towards the acceptance of laboratory approach in medicine.

Other physicians too saw the bacillus in the course of their investigations and examined the discharge of several cases to "ascertain whether some of the speculative views in regard to the presence of fungi and their influence in producing the disease could be sustained."[113]Assistant Surgeon William Thomson believed no "fungi" were present.[114]He examined the discharge and found it consisted of fluid, granular matter and debris. He agreed with Woodward that within the "thickened margins of the ulcers" there seemed to be a "multiplication of the connective tissue-corpuscles."[115]Like Woodward, he accommodated the disease to cellular pathology and outlined the changes he saw in the cells and the spreading of cells, to the disease. But, interestingly, in the same paragraph he recommended as a remedy, a local application of bromine to be applied to the diseased surface, after it had been cleared of all sloughs by removing all dead tissue.

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[112] Ibid.

[113] *Medical and Surgical History,* Vol. II, Pt. III pp. 843. Based on the report of Assistant Surgeon William Thomson at the Douglas Hospital, Feb. 1863. First published in the *American Journal of the Medical Sciences*, April 1864, Vol. XLVII, p. 378.

[114] Fungal theories of diseases held that the cause was the "seeds, spores, eggs or adult form of another organism, which was believed to alter the structure and function of the human body when they settled and developed in the unnatural milieu." See, Michael Worbys, *Spreading Germs: Medical Practice and Disease Theories in Britain, 1865-1900* (Cambridge: Cambridge University Press, 2000) p. 38.

[115] Attempts were made beginning in the 1850s to determine the role of red and white corpuscles in certain disease states. Physicians aimed to delineate the differences and similarities between white corpuscles and the pus cells found in abscesses, their relationship to similar cells found in loose connective tissue and finally their role in causing inflammation. See Bynum, pp. 124-26. Thomson's and Woodward's efforts suggest that they used Civil War bodies to both learn and contribute to debates surrounding Virchow's cellular doctrines.

So while the understanding of the disease process and cause of disease was imperfect, he did see the benefits of local treatments: if the disease was arrested by applying local remedies immediately was the disease an internal malfunction or rather a separate entity that acted locally?[116]

The physician Benjamin Woodward (no relation to Joseph) was asked to report on the microscopic appearance of the ichor of gangrene and gangrenous erysipelas. Ichorous infection was associated with the putrid matter in the wounds, cavities or gangrenous surfaces. Case reports comment frequently on the connection between "fetid discharge and ichorous infection."[117] Indeed, Goldsmith observed that in the most serious gangrene cases he often witnessed a "pungent and intolerable fetor."[118] He further reported that "in some cases the pungency of the gaseous effluvia was so great as to produce a persistent smarting in the eyes and nose of the persons engaged in dressing the sores." He continued,

> The odor would often fill the whole ward. This fetor, in greater or less intensity, was the almost constant attendant upon the gangrenous process, appearing when it began, continuing as it continued and ending when it ended. So constant was this coincidence, that those who treated the cases came to regard the disappearance of the fetor as the reliable evidence of the arrest of the disease; the presence of it as the signal of the commencement of the process.[119]

Thus it was common in the 1860s to differentiate between "good pus" (creamy, less foul smelling)[120]or "ichorus pus" (malignant pus, the result of more serious infection).[121]But what role did the pus have in the disease? Was it the cause or result of the disease? Benjamin Woodward submitted his report entitled, "Notes on the Pus and Ichor of Hospital Gangrene" to John Brinton early in 1863.[122]In his investigations he attempted to determine whether "pus globules" existed and the role that pus played in

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[116] As Margaret Pelling has shown, however, in the nineteenth century it was possible to "transpose the ontological idea to the cellular level, so that disease could be seen as invasive within the interior environment of the body." See, Margaret Pelling, "Contagion/Germ Theory/Specificity" in " in (eds) William Bynum and Roy Porter *Companion Volume of the History of Medicine Volume 1*(London: Routledge, 1993) p. 315.
[117] Goldsmith, p. 15.
[118] Ibid. p. 25.
[119] Goldsmith, p. 26.
[120] Probably the result of a less serious staphylococcal infection versus a more serious streptococcal infection. Bollett, p. 200.
[121] Ibid.
[122] RG 94 (NARA) Medical Records, 1814-1819, D File, Entry 205 Box 15. Ben Woodward to John Brinton "Notes on the Pus and Ichor of Hospital Gangrene." January 2, 1863.

these diseases.[123] He noted "this is by no means to be understood that there are no pus cells present but that the fluid instead of showing the globular cell with its nucleus having a disturbed and regular outline, shows that pus cells have been broken down and are so changed as to have the appearance of granular debris."[124] When he discussed the change in character of the pus cell he was actually observing the bacteria causing the infection, and as the disease was successfully treated he noted that the "true pus cells" were seen again as "healthy action was restored." Woodward used the microscope to study the manifestation and the different stages of gangrene. In particular he studied the changes in the tissues and the cells as revealed by the microscope. Woodward attempted to explain through his examination when and why good and bad pus would exist with the hopes of understanding better the pathology of gangrene:

> The process of decomposition of the tissues in gangrene and gangrenous erysipelas is evident from debris of fibre—cell and blood discs—these both I believe always exist in a shriveled irregular form in gangrene—while in good pus from healthy wounds they are never found unless new granulations have been ruptured. In "gangrene ichor" blood globules can always be found coming from the small vessels which are ruptured and destroyed, but always in an irregular form. While in healthy pus they never exist unless violence has been done to the new tissues formulating granulation. The existence of pus observed in the other go to when pus is not a process of decomposition, but is a true secretion indicating that the process of suppuration is going on, and is designed to protect and nourish the forming granulations. I do not now speak of that form of suppuration which is set off in abscess, or which is caused for instance in inflammation of articular surfaces, but of that fluid which attends the healing process of wounded tissues.[125]

The goal was "healing by first intention," (when tissues repaired with little inflammation)[126] which never happened in the presence of "ichorus pus" when serious infection would develop, and perhaps get into the blood (which may or may not have contributed to the severity of the infection). Unfortunately, Woodward believed that the wounds would heal under pus (as less serious wounds often did), due to his relative inexperience with these diseases. He did recognize, however, the complications from sepsis (which he refers to abscesses-meaning pockets of pus) which would aid the spread

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[123] The role of pus, white corpuscles, inflammation and cells as observed in diseased states were the subject of much debate in the second half of the 19th century. Woodward's investigations again reveal the dynamism that characterized Civil War medicine. For more on the debates concerning the "nature of pus" please see Bynum, pp. 122-127.
[124] Ibid.
[125] Ibid. He advocated treatment for gangrene; however, depending on the severity of the wound he did suggest that tissues could regenerate due to their vitality.
[126] Ibid. Associated here with extensive swelling of the tissues.

of the disease by invading more tissues and cause putrefactive decomposition.[127]This was considered a process and thus the goal was to arrest putrefaction in the wound by some kind of substance.[128]

But his work here did lead to some interesting discoveries. Ben Woodward was convinced that the disease had contagious properties, and that it was the gangrenous matter spreading from wound to wound that was responsible for the outbreaks. He informed Brinton that he would like to report an interesting finding.[129]He conducted an experiment in which he took a clean tube, filled it with filtered glycerin, placed one end of the tube close to a gangrenous wound "which was a wall of putrefactive gangrene" and placed the other end of the tube in his mouth and drew "putrid gas through the tube" until he nearly "fainted with the stench."[130]He then closed the tube and left it for 24 hours, after which time he put it for examination under the microscope. He used a 1/8 inch objective in his examination and discovered "numerable cells." He noted that consolidated glycerin developed around each cell in the tube and he "then went to a man with a perfectly healthy wound and inoculated his wound with smeared glycerin from inside the tube."[131] He placed the patient in a ward with no gangrene whatsoever, monitored the patient closely, and found within 16 hours that "gangrene was well developed in the wound."[132] He asked Brinton to consider the possible causation of this disease: "is cell matter thrown off from the gangrenous surface and floating in the air (contagious-miasma), and ichorus the "morbus cause" (infection) in another case?" In trying to determine the cause he reverted back to familiar assumptions about poisons escaping from the body and carried by air to other bodies. However, he assured Brinton that in this case "gangrene was caused by contact" but also that "it is evident that the disease may be caused by "cell matter" in the atmosphere and I think I see how disease can also be communicated in this way."[133]Of course the two ideas were not unconnected. He did not let go of his initial ideas about disease; however, his experiments clearly

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[127] As the disease spread into the blood stream, other infection sites would or could arise in the body.
[128] Goldsmith, p. 16.
[129] RG 94 (NARA) Medical Records, 1814-1819, D File, Box 15 Entry 196. Letter entitled "Letters and Experiments on Hospital Gangrene and Concerning Pathological Specimen" from Ben Woodward, US Hospital Tullahoma, Tennessee to John Brinton January 2, 1863.
[130] Ibid.
[131] Ibid.
[132] He treated the patient with bromine successfully; but very little concern was expressed for the patient in this letter.
[133] Ibid.

challenged his ideas about causation. It is interesting that Woodward during the course of his investigation with gangrene patients confirmed that contact with matter from one wound could be spread to another. It is also significant that he isolated the disease (Koch's third postulate), cultured it and grew it outside the body (Koch's fourth postulate) and inoculated it into a patient to produce the same disease (Koch's fifth postulate) foreshadowing modern laboratory practices in his investigations. While he did not yet understand the role of the microorganisms that he saw under the microscope, his experiments raised some important questions about disease: Did disease germs exist? Where did they originate? Was the exciting cause of disease then actually a living "cell" rather than a chemical breakdown in the body? These findings were important to Woodward and he looked for further opportunities to develop his research. He wrote to Barnes just three months after his gangrene experiments noting, "The reason why I wish a situation in a hospital is that I may be enabled to study the microscopic existence of pathological cell formation and proving the theory of cells in the air from various diseases."[134]

Perhaps most interesting, however, was his belief in experimental method to produce knowledge about disease. There was clearly a new mind-set about how to study disease that developed in the Civil War hospitals. As physicians were forced to come to terms with the limitation of their own medical knowledge they sought new, more scientific methods to produce knowledge about gangrene and erysipelas, which included experimentation with various remedies and therapeutic trials (to be discussed below), chemical and microscopial examination of morbid materials and even inoculation. Moreover, there was palpable enthusiasm for experimentation and the opportunity to produce knowledge about the Civil War body, illness and disease. As medicine moved away from purely clinico-pathological processes and towards physiology, chemistry and microscopy physicians moved towards the idea of "experiment" for producing medical knowledge. The site of knowledge was moving away from the hospital and towards the laboratory for some physicians (although during the war these were inextricably linked) but the mind-set about how to produce knowledge about patients and disease was shifting

[134] RG 94 (NARA) Adjutant General's Office Personal Papers of Medical Officers and Physician Files, Entry 561 Benjamin Woodward Box No. 657. Letter to Barnes from Ben Woodward, March 11, 1863.

for some. The experiments were mostly related to therapeutics but there were some interesting experiments related to the processes of disease (not unrelated).

Physicians clearly relished these experiments, but there was a practical concern: patients were suffering and needed to be treated. Almost every case report discusses the suffering of the patient but they also reveal how very important the patient was in the management of these diseases. The development of this doctor-patient relationship was highly valued by physicians. Patients could describe the pain, symptoms and history which allowed a clinical and epidemiological picture to be established. These were extremely painful diseases and patients dreaded the idea of contracting either disease, although gangrene was seen as the worst of the two. Solon Hyde, a hospital steward for the 17th Ohio Volunteers, observed while being held prisoner of war in Danville prison that prisoners were terrified to receive a vaccine since "so poisoned were our systems that I would rather have taken my chances on smallpox than to open a suppurating sore, almost certain to follow vaccination in a system full of scurvy and everything about having a tendency to foster gangrene."[135]The physician R. Weir noted in his report on gangrene that his patients felt dejection, almost despair when suffering from this disease. He conducted examinations in "which the character of the pain was investigated" and was described by the patients as "being of a burning or stinging nature."[136]He observed that "to so great a degree did this depression proceed, that during a period of two months a suicidal disposition was manifested in the patients in whom the severity of the disease was pronounced."[137] He further noticed that this arose from "the painful nature of the disease or from the severity of the treatment pursued and in almost every case a marked degree of dependency was noticed" challenging the commonly held beliefs of manliness and war.[138]Men became more emotional as they faced their own mortality. Part of this was due to the lack of honor associated with dying from disease rather than fighting. One

[135] *A Captive of War: Solon Hyde, Hospital Steward, 17th Regiment Ohio Volunteers Infantry.* (Ed.) Neil Thompson (Burd Street Press, Shippensburg, 1996): p. 86.
[136] RG 94 (NARA) Reports of Diseases and Individual Cases File A Entry 288 "Remarks on Hospital Gangrene" From USA General Hospital Frederick Maryland, R.F. Weir, March 1863.
[137] Ibid.
[138] RG 94 (NARA) Reports of Diseases and Individual Cases File A Entry 288 "Remarks on Hospital Gangrene" From USA General Hospital Frederick Maryland, R.F. Weir, March 1863.

soldier remarked that death from disease has "all the evils of the battlefield with none of its honors."[139]

The physical destructiveness of gangrene (men could literally see their limbs rotting from the disease) made it particularly difficult to contend with.[140]S.D. Mobry a Confederate Private from the Alabama Regiment was admitted to the USA General Hospital in Frederick and treated by Assistant Surgeon North, who was in charge of the gangrene patients in the hospital. Mobry had been wounded at the Battle of Antietam in September, 1862 and admitted on October 22 with two flesh wounds in the right side of the trunk and a compound comminuted fracture of the right leg. On November 10, the gangrene appeared on the right side of the trunk, but not his leg. It was observed that he "experienced a burning pain which prevented sleeping at night."[141]He had developed a "livid areola surrounding the wound, which had assumed a circular form, with ragged indurated and everted edges." His general health also began to suffer and it was noted that he was suffering from "loss of appetite and chills." The patient was removed to the gangrene tent and treated with oakum, strong nitric acid and given tonics internally. The disease was aggressively treated for ten days and began to improve; it was completely arrested within a couple of weeks and he was moved out of the gangrene tent. But the disease was formidable. It was noted in his file that while the first wound had cicatrized rapidly the disease now appeared in the wound on his leg. He was removed again to the gangrene tent to begin another course of nitric acid, where it was specifically noted that the "patient's general condition is very poor, his mind much dejected and filled with foreboding."[142]He refused to eat and Dr. North noted, "the disease is making rapid progress having involved and destroyed almost entirely the soft parts upon the posterior inner aspect of the lower third of the leg, exposing bone about four inches." North also noted that the muscles, arteries and nerves had "become involved" and were being converted into a "blackened, disorganized pulpy mass exhaling a peculiar odor which can

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[139] Quoted in Drew Gilpin Faust, *This Republic of Suffering: Death and the American Civil War* (Knoph: New York, 2008) p. 4.
[140] Issues related to gender, particularly, the loss of masculinity and the dependence on their women care givers will be considered in the larger monograph.
[141] RG 94 (NARA) Reports of Diseases and Individual Cases File A Entry 288 Case of S.D. Mobry Private, Alabama Regiment report submitted by R.F. Weir Assistant Surgeon USA General Hospital Frederick Maryland, March 1863.
[142] Ibid

be recognized in every part of the tent."[143]The whole limb was swollen and painful on pressure and the patient complained of "burning pain." The doctors considered amputation of the thigh but since it was almost always fatal, settled on acid applications. After the patient was etherized and all the "sinuses resulting from extension of the gangrene among the muscles freely laid open and the pultaceous slough" (dead tissues) removed with scissors, "strong nitric acid was placed in the wound" and "worked in by a sharpened stick."[144]To arrest the spread, acid was placed on the adjacent healthy parts, the patient was administered morphine, brandy and beef tea every half hour, and a clean dressing of oakum, soaked in a lotion of acid and water, was placed on the wound at intervals of two hours. The patient was monitored closely, and his attitude was deemed important for both his prognosis and for helping physicians understand the nature of the disease. Three days after the procedure it was noted that the patient was "quite cheerful," "gaining strength and eating well" and suffered "little shock" after the application of the acid. But he continued to battle the recurrence of the disease until finally dying three months later after the onset of erysipelas.

Despite the unfavorable outcome of the above case, case reports reveal how important the patient was in the management of these diseases. In attempting to develop a picture of these diseases, including their pathology and epidemiology, patients became a prized clinical resource. In February, 1863 John Brinton was dispatched to study hospital gangrene in the General Hospital at Annapolis. Hammond requested that he "inquire into the origin of the disease" and the "means adopted for its treatment."[145]Brinton stayed at the hospital for three days to monitor the disease. He conducted a study of the sixty patients who were at that time suffering from gangrene and used three primary sources in his investigation: interviews with the physicians and attendants; examination of the case records and statements of the patients themselves.[146]The patients helped Brinton to trace the disease and create a picture of the disease in its varying stages based on pain. Having patients to question was compelling for Brinton:

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[143] Ibid
[144] Ibid.
[145] RG 94 (NARA) Reports of Diseases and Individual Cases File A Entry 254 "Report in Relation to the Existence of Hospital Gangrene in the Hospital at Annapolis" By John Brinton for Surgeon General Hammond, February 7, 1863.
[146] Ibid.

> Prior to January 11, 1863 no hospital gangrene existed in the institution. On this day 153 patients were brought from Richmond, VA. very many of these men were wounded and all had been closely confined in the prisons and prison hospital of that city. Of these 153 men, 4 had hospital gangrene at the time of admission and 3 have since contracted it. On Jan 29, 421 patients were admitted into hospital from the same place and under the same circumstances. Of these, in 14 wounded patients the gangrene existed at the time of admission, in 3 it developed subsequently. On Feb. 5 and 6th, 86 patients were in like manner admitted. In 4, the gangrene existed prior to admission; in 2 cases it was subsequently developed.

He interviewed three sets of patients, who had contracted gangrene from different sources in the attempt to determine whether the diseases existed prior to their admission into the hospital and discovered that "many of them referred the origin of their sores to their confinement in the 'Libby Prison' of Richmond and the hospital adjacent." The prison was notoriously crowded, dirty and medical attention was scant.[147]It was found that gangrene was "very prevalent." The second set of patients had been taken prisoner at the "recent western battles" and described their gangrenous ulcers as being contracted "on their difficult transportation from the West to Richmond." The cars were described as "closed boxes, overrun with vermin" with "deficient and miserable food." The third set of patients described their ulcers as appearing first while on a steamer en route to Annapolis in which conditions were described as "overcrowded and filthy."[148]These interviews confirmed Brinton's opinion that these diseases were contagious (some form of poison), which would thrive in filthy, crowded conditions and attack individuals in a debilitated state. He therefore agreed with the treatment being administered in Annapolis, which was the local application of bromine, along with the internal administration of tincture of iron and quinine, stimulants, malt liquor, beef tea and nutritious diet.[149] The method of treatment and the remedies employed in the hospitals could make a huge difference to the patient experience with these diseases, and patients now treated in the hospital for an extended period proved an invaluable resource in which to test remedies.

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[147] Libby was a Confederate Prison in Richmond, VA. It was a three story brick warehouse on "Tobacco Row." It was known for its lack of sanitation, severe overcrowding and diseases such as diarrhea and typhoid fever. Numerous Union soldiers died while at Libby during the years 1863-1864. See William Hesseltine, *Civil War Prisons: A Study in War Psychology* (Columbus: Ohio State University Press, 1930); William Hesseltine, *Civil War Prisons* (Kent: Kent State University Press, 1962)
[148] RG 94 (NARA) Reports of Diseases and Individual Cases File A Entry 254 "Report in Relation to the Existence of Hospital Gangrene in the Hospital at Annapolis" By John Brinton for Surgeon General Hammond, February 7, 1863.
[149] Ibid.

Circular No. 2, which had stimulated knowledge and interest in localized pathology led also to interest in the chemistry of the body, which had an important effect on therapeutics. Indeed, the vast amount of experience with patients suffering from these diseases proved to be very important in stimulating pathological chemistry, particularly, because of the bodily fluids associated/resulting from these diseases. On March 19, 1863 Thomas E. Jenkins, assistant surgeon in Louisville, Kentucky, submitted to Hammond his report entitled "On the Chemical and Physical Character of Sloughs resulting from Hospital Gangrene." He was invited by Hammond to conduct these investigations into the nature and composition of the substances resulting from the actions of the morbid processes of hospital gangrene. It was also compatible with Virchow's work, who recommended chemical investigations into the body to understand disease processes. In his study, Jenkins commented on how these diseases challenged the present knowledge of disease and conceptions of disease (which were generally thought to be a complex organic chemical). This was an excellent way to incorporate chemical methods in medical research, thus developing the basic sciences and supporting the development of this research. He attempted to throw light on these diseases with his chemical investigations:

I have undertaken these researches and **commenced a series of experiments** having for their object the accurate determination of all the substances resulting from the diseased action and their compositions, with a new view of discovering the agent or agents procuring such morbid action, or to find out some prophylactic or antidote for such materials as give rise to the disease.[150]

He undertook a series of experiments, beginning by conducting a physical investigation into the altered tissues involved in the "destruction produced by ulcerating processes of gangrene" and the new formulation resulting from such "destruction or alteration." The

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[150] RG 94 (NARA) Medical Records, 1814-1919 D File, Box Three. "On the Chemical and Physical Character of Sloughs resulting from Hospital Gangrene" March 19, 1863, submitted by Tho. E. Jenkins. My emphasis here. I am often asked if physicians used the word experiment. Those engaged in therapeutic trials, chemical and microscopial investigations did use the word experiment. It is important as it suggests a specific cast of mind. Similarly, the southern physician J. Chambliss conducted numerous tests on the chemical properties of hospital gangrene in which he mixed nitric acid with gangrenous matter and sent in a solution of distilled water to Joseph Jones. He noted that he had "tried this experiment with matter taken from this and other wounds affected with gangrene" and his experiments continually produced a "pink colored precipate." He compared the solution with so called healthy pus, which produced a white coagulate and he also tested the matter taken from the body of a decayed rat. Jones conducted separate experiments to test for the presence of the disease but found the results were not uniform. The experimental mindset and development of chemical experimentation was important in garnering support for laboratory style medicine. See, *Surgical Memoirs of the War of the Rebellion Collected and Published by The United States Sanitary Commission* (ed) Frank Hastings Hamilton (New York: Hurd and Hougton, 1871) pp. 274-275.

resulting matter of gangrene was found to have special properties which were "solid, liquid and gaseous." Jenkins then examined extensively the matter of gangrene:

> The solid portion is comprehended in the slough and is composed simply of a pultaceous amorphous mass, generally associated with mass or less of pus corpuscles. The ultimate composition of this sloughy matter is about the same as the healthy tissues themselves, with the exception of sulphus and phosphorous which appear to be diminished in quantity. I have found in a few specimens portions of inelastic fibrous tissue which had resisted the disintegrating action of the morbid process. Up to this time hardened and black portions have to a great extent been disregarded. The pus found mixed with the sloughs is very similar to ordinary pus to the unaided eye, being composed of a multitude of corpuscles mixed with pultaceous matter and some fluid (its odor was extremely putrid almost intolerable.) When examined by means of the microscope the corpuscles of pus were of a moderately spherical form, but opaque and rough and granular, and presented a slightly yellow appearance, and were very easily broken down by compression under the glass, in a number of corpuscles very few compared with laudable pus, and many were partially broken down and becoming destroyed, they developed nuclei when treated with nitric acid. The wall of the corpuscle was little transparent almost opaque until treated with nitric acid and was covered with slight granulation. The fluid portion of the mass was thick and of light yellow color, and possessed a most repulsive odor.

Jenkins was frustrated that he could not explain the chemical changes that were produced by the disease. He could not understand why these chemicals initiated specific disease processes; he did see the bacillus but did not yet connect the bacteria with the disease:

> As was mentioned about the solids contained the ultimate constituents of the tissues in about the natural proportion, sulphur and phosphorus accepted, which are in diminished quantity. I was led to look for the lost elements in the gaseous products of decomposition. There I know I would find S and probably P and expected changes would be combined with H and WH3, but they are wholly disposed of in that manner; there is a minute quantity of HSWH3 in the gases; but a portion of these elements exist in a much more complex state of combination and give rise to what I have reason to believe to be an alkaline body containing S & P as an essential constituent, a new body containing not only C, H, N & O, as most of the organic alkaloids are higher and much more complex than the alkaloids we are acquainted with as albumen is higher in its organization than sugar or fat. The further elucidation of this matter is the subject of my future experiments....in future communication I may be able to give you the exact constitution of this or these new bodies.

He assumed, like many other doctors of this period, that the disease was the result of a chemical breakdown due to some kind of poison. The new bodies he witnessed had some role in the disease but what were they? And where did they come from? Were they living or chemical? Were they the cause or the result of the disease? As Jenkins noted early on, the full capacity of these diseases seemed to be beyond the knowledge of the general physician, but they did stimulate study, debate and analysis. In fact, because of the challenge in understanding the etiology of hospital gangrene and erysipelas, physicians continually searched for opportunities to contribute to the scientific knowledge of these diseases, which was perhaps most pronounced in the therapeutic investigations related to the management of them. For example, Jenkins reported that antiseptics would effectively combat the diseases by decomposing the organic body, abstracting water, forming with organic matter compounds less susceptible of decay, by deodorizing the body and/or by destroying cryptogamic plants and infusorial animalcules.[151]

The Management and Treatment of Gangrene and Erysipelas:

Hospital gangrene produced local lesions and then systematic changes upon the whole body. Physicians understood this manifestation which proved to be an important stimulus for therapeutics. But as more physicians supported the idea that gangrene and erysipelas had a local cause, it strengthened the idea that the disease was a "thing" to be killed, which influenced the course of treatment adopted. They could see the eradication of the disease as local treatments destroyed the toxins responsible for its spread. Whether the disease was thought to have local or constitutional origins, the goal was to adopt a specific antiseptic that would "break up the putrescent actions either directly or indirectly."[152] Physicians were advised to apply a remedy as soon as the wound showed signs of infection. An escharotic was applied to the slough (to separate infected and healthy tissue) the goal being to stop the spread of the infection.[153] After the wound was cleaned and damaged tissue was removed a disinfectant was applied in and around the wound. Finally, the wound was covered with dry lint, which was soaked in turpentine or some other disinfectant and the patient was ordered to rest.

Physicians actively and passionately debated various treatments, including the use of bromine, nitric acid, turpentine, permanganate of potassa and iodine, and these debates proved important in stimulating developing ideas about body chemistry and how

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[151] Jenkins report to Goldsmith, reprinted in Goldsmith, p. 22.
[152] Goldsmith, p. 16.
[153] This technique, also known as debridement, consisted of applying the remedy to the diseased surfaces but also just beyond to the sound parts so that the disease could not spread. It was very painful thus patients were often given anesthetics prior to treatment.

remedies could arrest the disease by the use of various chemicals. As Goldsmith wrote, "a series of investigations is now on foot seeking to discover the essential agent, if one exists, which sets up these diseases."[154] Though the British Surgeon General recommended nitric acid as a treatment for gangrene and erysipelas,[155] the war provided an opportunity to expand the knowledge related to these diseases and physicians were experimental, industrious and moved beyond previously accepted treatments.[156] Part of the desire to find other remedies were due to the application of nitric acid proving extremely painful for the patients, as a number of physicians commented in their reports. Thus the war proved to be an opportunity to experiment with different treatments and for the first time some scientifically inclined physicians could conduct clinical trials with their hospital patients. The scope of the work is particularly revealing because in the pre-bacteriological era physicians generally had their own ideas and techniques about how to best manage septic diseases.

Frank Hinkle, assistant surgeon at the Jarvis General Hospital undertook extensive experiments with permanganate of potassa in the treatment of hospital gangrene. Dewitt C. Peters, the surgeon in charge of Jarvis General Hospital noted of Hinkle's work:

> The attention of the Surgeon General is respectfully called to this highly important special report. I am firmly convinced that the use of permanganate of potassa will become general in the treatment of hospital gangrene. The experience here is decidedly in its favor, some cases have especially yielded to the treatment of the salt. Dr. Hinkle deserves great credit for introducing this valuable agent and thoroughly studying its properties. The remedy is highly popular with the soldiers, who don't dread hospital gangrene as much.[157]

Hinkle was an extremely conscientious and well liked physician. Describing a soldier suffering from depression following an amputation after the Battle of Fredericksburg, Walt Whitman observed that the young patient "thinks a great deal of his physician here, Dr. Frank Hinkle, and as some fifty other soldiers in the ward do the same, and bear testimony in their hearty gratitude, and medical and surgical imprisonment, to the quality

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[154] Goldsmith, p. 17
[155] Particularly during the Crimean War.
[156] Bromine, as Goldsmith would demonstrate, had a far lower mortality rate than nitric acid.
[157] RG 94 (NARA) Reports of Diseases and Individual Cases File A, Entry 263 Jarvis General Hospital Nov. 6, 1863 an introduction by Peters in the report entitled, "Remarks on the Use of Permanganate Potassa in the Treatment of Hospital Gangrene" by Frank Hinkle, Assistant Surgeon, U.S.A.

of Dr. Hinkle, I think he deserves an honorable mention to the people of our city."[158]In addition to being well respected for his work at Jarvis General Hospital, he was also admired for his scientific work, especially pertaining to hospital gangrene. He first became apprised of permanganate of potassa as an experimental remedy to be used in the treatment of hospital gangrene when it was suggested to him by Professor Samuel Jackson of Philadelphia, who had been in communication with a French doctor also using the chemical compound as an experimental remedy.[159]Hinkle ascertained where to obtain the permanganate of potassa, and at his own expense, purchased a few ounces of the compound. This was relatively uncommon but as he remarked to Hammond, "the investigations and study of hospital gangrene had for sometime occupied my mind."[160]He looked at the American experience with using permanganate of potassa as a remedy and found that within the *US Dispensary* that the application of salt internally as a treatment had been used only for diabetes and as a "deodorizer in certain ulcers" but "the information was too vague to be of use as a guide."[161]He searched for other authorities, but could find none who had employed salt as a remedial agent and believed he was the "first to employ it generally in the treatment of hospital gangrene."[162]

He determined to conduct a trial using this antiseptic agent, which he believed would kill the poison responsible for disease.

> I must beg leave to differ with the general opinion that hospital gangrene is solely dependent on filth, crowding and bad ventilations in the production of the disease. No doubt they tend to aggravate its infection but to my mind they are mere exciting causes while the specific poison rests in the blood, which from irregularities in the life of a soldier his arduous duties and exposure becomes impoverished. The proof that this assertion can be readily noted in hospital where we find soldiers laboring under such diseases as camp fever, diarrhea, scurvy and various chronic complaints. Wounds that have from unavoidable neglect not been properly dressed or when dressed have not been properly cleansed may invite the disease and having once made its introduction I admit it spreads like wildfire to those susceptible.[163]

[158] Walt Whitman quoted in the Brooklyn Eagle, 1863. From, Walt Whitman, *Wound Dresser: A Series of Letters written from the Hospitals in Washington During the War of the Rebellion.* (Small and Maynard Company, 1898) p. 15.
[159] RG 94 (NARA) Reports of Diseases and Individual Cases File A, Entry 263 Jarvis General Hospital Nov. 6, 1863, "Remarks on the Use of Permanganate Potassa in the Treatment of Hospital Gangrene" by Frank Hinkle, Assistant Surgeon, U.S.A.
[160] Ibid.
[161] Ibid.
[162] Ibid.
[163] Ibid.

Providing evidence for his claims he mentioned his tenure at Campbell Hospital, Armory Square Hospital and Jarvis General Hospital where he "witnessed gangrene visits in its worst forms" and where "every care was given to prevent contagion, and I am free to say that these institutions are models for cleanliness, ventilation." Even though he was meticulous with sanitation measures including the employment of sanitary police, getting rid of stagnant water, isolated buildings, daily fumigation and white washing once a week inside and out, "in each of these hospitals the disease has raged to a fearful extent."[164] He believed the disease "rested in the blood" which supported a physiological conception of disease but he also saw that the disease was contagious.[165]Disease was traditionally thought of as an internal malfunction that could escape from the body by air or water, but ideas of contagion were less developed. With the investigation into these diseases, physicians began to think about how disease was spread and caused. Assuming the disease to be contagious, Hinkle adopted very strict measures in handling the disease. At Jarvis, for example, a large tent ward was erected, which was elevated from the ground on a fresh bed of clean, dry sand, having a new board floor. This ward was "so located that it was free to the fresh air on all sides and was kept in a perfect state of cleanliness." The patients were taken to the ward "as fast as the disease appeared and returned as soon as it was arrested." The patients' wounds were covered with bandages and dressings and each patient used his own towels and sponges. The disease puzzled Hinkle, because in the face of these hygienic measures "hospital gangrene prevailed insidiously." He thus decided to introduce permanganate of potassa to the Campbell General Hospital in May of 1863 to experiment with cases received from the second Battle of Fredericksburg, ordering it privately from a chemist in Philadelphia, though once Hammond was apprised of its efficacy it was supplied by the government on requisition.[166]

Permanganate is a chemical compound which takes the form of a salt and is a strong oxidizing agent. It dissolves in water, has a sweet taste and is odorless. Hinkle conducted a study with fifty patients in Campbell hospital, where he was able to perfect his "modus operandi of employing the remedy." He used from "one to four grains in a

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[164] Ibid.

[165] His almost draconian hygienic measures suggests that he did not just see the disease as a physiological disturbance in function that could be countered by chemicals employed—his actions suggest a more complex approach to the transmission of the disease.

[166] The government purchased the solution from Henry Bower a chemist from Philadelphia.

solution of water" as a "tonic astringent to oxygenate the blood."[167]He applied the solution primarily locally as an escharotic (a corrosive substance which produced a scab) so that the tissue would die and begin regenerating.[168] He applied the solution with a hair pencil (to avoid damage to surrounding normal tissue), extending the application over the cuticle four inches beyond the seat of the wound after which time he would saturate lint with the dilute solution and apply to the wound every three to four hours.[169]Previous to the application of the solution the wound was to be thoroughly cleansed with "castile soap and water" and in cases where the wound was too difficult to access, the concentrated solution was injected with a syringe two to three times daily. He found that with the local application of the solution "the most aggravated cases of gangrene resulting from traumatic wounds were arrested" after which time the treatment was usually modified to "suit the state of the wound until healthy granulation ensued."[170] His report noted that in most cases the gangrenous slough usually disappeared within five days, although simple dressings with a dilute solution continued to be applied until the wound was entirely healed.[171]He found that using the remedy as both a simple dressing and a tonic astringent, "anti-hemorrhagic" and "vivifier of the feeble circulation in the flaps" for bed-sores and for the treatment of stumps after amputation it "prevented sloughing" and helped "maintain a healthy tone in the parts."[172]

He also used permanganate prophylactically with great success. He treated gunshot wounds with a dilute solution before gangrene had the chance to appear and observed "I feel assured that gangrene would have attacked the wounded parts had it not been employed." He further used it as a deodorizer to "destroy all the offensive odors emanating from gangrenous wounds, which is a sanitary point gained in a surgical ward."[173] In order to ensure that the ward was "properly sanitary" he employed it as a

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[167] The solution used by him (and eventually furnished by the government) was from two to four drachums of the concentrated solution added to a pint of water, the stringents varying in accordance with the severity of the case.
[168] He clearly reconciled the idea that a "thing" or disease entity could also be invasive within the interior of the body. Not uncommon in the 19th century. See, Pelling p. 315.
[169] RG 94 (NARA) Reports of Diseases and Individual Cases File A, Entry 263 Jarvis General Hospital Nov. 6, 1863, "Remarks on the Use of Permanganate Potassa in the Treatment of Hospital Gangrene" by Frank Hinkle, Assistant Surgeon, U.S.A.
[170] Ibid.
[171] Ibib.
[172] He found that in cases of hemorrhage that by applying the concentrated solution with a hair pencil and then soaking lint dressings with the solution for twenty four hours served to control the hemorrhage.
[173] Ibid.

disinfectant, "placing tin saucers under the beds and used by the nurses after dressing offensive wounds." Hinkle was so fascinated with the usefulness of permanganate of potassa that he also used it as a disinfectant after performing post mortems.[174]Since some physicians during the war liked to study the body extensively, he also found the properties of permanganate of potassa beneficial for preserving cadavers:

> In meditating on its physiological action the following question occurred to me: if it arrests the progress of suppuration and disorganization of all the living tissues why will it not suspend the process of decomposition in the dead? Acting on this theory I injected the femoral artery of a deceased subject with a concentrated solution of this salt and left the body unburied for seven days. At the expiration of that period, I with several other medical officers inspected the body and found it to be in a perfect state of preservation. In conclusion I will merely add that I consider the Permanganate of Potassa to be a boon to humanity in the treatment of hospital gangrene and that it compares favorably with the valuable properties of chloroform and ether.[175]

Hinkle tested the remedy on a number of patients and he was pleased with the results. For example, Private Charles McElroy of Connecticut suffered a particularly painful case of gangrene after receiving three wounds to the left leg at the Battle of Gettysburg, July 1863. He was admitted to the Jarvis General Hospital in Baltimore and treated by Hinkle. His case report noted upon his admission that "the limb presented a frightful appearance, the vitality having been destroyed far beyond the seat of the injury terminating all in extensive suppurative inflammation and sloughing. The length of the wound is six inches."[176]The patient developed gangrene on September 3, 1863 when he was "seized with violent constitutional disturbance, a high grade of fever, pain in his head, back and limbs with frequent chills." Gangrene set in, the wound was opened "everting the integument and the pulpous variety of the slough was presented en masse elevating itself fully two inches above the level of the wound of a dark colored appearance apparently liquefying the flesh every hour as it progressed." Hinkle then examined the pus which was described as "highly pungent and very offensive in odor so much so that the nurses and those in attendance could scarcely remain a moment in his

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[174]Once again we see how concepts of contagion developed during the war. Semmelweis similarly made the connection between the post-mortem room and the delivery room as medical students often traveled between the two in the hospitals and in the process transferred "lethal material from the dead to the living." See, Waller, p. 63

[175] RG 94 (NARA) Reports of Diseases and Individual Cases File A, Entry 263 Jarvis General Hospital Nov. 6, 1863, "Remarks on the Use of Permanganate Potassa in the Treatment of Hospital Gangrene" by Frank Hinkle, Assistant Surgeon, U.S.A. This work also further elucidates the "experimental mindset" that was able to develop during the war.

[176] RG 94 (NARA) Reports of Diseases and Individual Cases File A, Entry 263. Case Three, Charles McElroy Co. K, 17th Connecticut Volunteers from Frank Hinkle's Case Report, Jarvis General Hospital.

presence without experiencing sickness of the stomach."[177]The patient was suffering and "sank rapidly under the disease" and was thus monitored hourly "night and day" and treated with "nervous stimulants" and a healthy diet. Hinkle then began a course of treatment with permanganate of potassa which was continued daily for a month, administered every hour for the first three days. Seventeen days after being infected with the disease, the patient began to recover: his appetite improved and two weeks later the wound "granulated up beyond expectation and more than three fourths of the wound cicatricized under this treatment."[178]This report is a good example of the knowledge produced during the war being used to combat new and formidable diseases, in this case a new therapeutic remedy which had immediate and significant clinical relevance.

Physicians also experimented with turpentine in the treatment of hospital gangrene. The physician G.P. Hachenberg conducted experiments using it as a topical treatment of the disease in the USA General Hospital in Nashville and was pleased by the "uniform good results obtained from its use."[179]Turpentine had been used medicinally for centuries and was heralded for its antiseptic properties; it is a chemical solvent, obtained from the resin in pine trees, and is still used medicinally (it is one of the ingredients in chest rubs such as Vicks). Hachenberg applied turpentine thoroughly to gangrenous wounds every three hours and where there were "fistulous openings involving the wound, they are at the same time well injected with it."[180]To prepare the wound for administering the turpentine, he recommended thoroughly cleaning the wound with warm water and any "ordinary disinfectants" and dissecting the wound if any "fascia are involved." He noted that the wound may be "perfectly saturated with the turpentine" and that it caused "little or no pain," but physicians were warned not to let the turpentine come in contact with the skin, which would cause inflammation. Hachenberg noted that after a few days the "slough falls out, discharges become laudable leaving a basis with an active tendency to granulation." He also observed that as the local lesion repaired itself, constitutional symptoms similarly improved. He studied the chemical properties of turpentine and suggested seven reasons why its therapeutic properties made it the most "reliable agent

[177] Ibid.
[178] Ibid.
[179] RG 94 (NARA) Medical Records, 1814-1919 D File, Entry 257 "Use of Turpentine in the treatment of Hospital Gangrene." Submitted by G.P. Hachenberg March 20, 1864.
[180] Ibid.

for treating hospital gangrene." Septic poisons spread destructively to the adjacent tissues and thus chemicals could be used to arrest this process. In particular, Hachenberg emphasized turpentine's "permeability," that it is a "ready solvent of the broken down adipose tissue of the wound," that it has a "local alternative stimulating affect," "its antizymotic properties," its "antiseptic benefits" and that it caused no immediate "chemical eschar such as bromine, nitric acid, which often means the retention of vitiated secretion of the wound."[181]In contrast to Hinkle, he wanted a non-escharotic because he felt that the damage caused by an escharotic to the surrounding tissue was too great and that after the scab healed, the disease may still spread to vulnerable tissues. He believed that gangrene was some kind of poison obtained externally, spread internally and easily passed to others. He suggested that the poison could break down tissues and cause chemical changes in the body. Because the turpentine had "antizymotic properties" he was employing it to counteract the "poison," finding its antiseptic benefits effective in preventing the spread of the disease, without causing much related damage.

Bromine was also used during the war and was seen as something of a miracle drug in the treatment of erysipelas and gangrene. It is a chemical similar to chlorine and iodine and is also a powerful antiseptic agent; its vapors are corrosive and toxic. A number of physicians used bromine with much success in the treatment of gangrene and erysipelas.[182]In the summer of 1862 Goldsmith was sent to Nashville and Murfreesboro in order to conduct special investigations into hospital gangrene and erysipelas.[183]His objective was to determine the epidemiology, pathology and etiology of these diseases. While there, he traced the "history of the causes of two outbreaks of disease, the one of erysipelas the other of hospital gangrene."[184]He noted that the occurrence of both disease outbreaks "were somewhat peculiar" and thus the "facts are pregnant with suggestions of scientific import." In tracing the cause of gangrene, he found that the disease was of an "indigenous origin," meaning where a "man having been brought into a ward with

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[181] Ibid. The theory of secretion, advanced first by George James Guthrie said that poisonous matter could be rapidly absorbed from the infected atmosphere of the crowded wards, and the disease could be propagated from the local wound to the central organs (usually in cases where the patient was physiologically predisposed—the last idea is challenged during the war in these investigations). See, *Surgical Memoirs of the War of the Rebellion*, p. 241. Physicians also spoke of "auto-inoculation" or absorption when discussing these diseases.

[182] Bromine worked by inhibiting the further growth of the bacteria rather than directly killing them (as antibiotics do.)

[183] RG 94 (NARA) Reports of Diseases and Individual Cases File A, Entry 261 "Report of Hospital Gangrene in Nashville and Murfreesboro" by Middleton Goldsmith Surgeon U.S.V. for the Surgeon General July 12, 1863.

[184] Ibid

hospital gangrene imparts the gangrenous character to the wounds of other men."[185]The clinical observations thus informed his experimental ideas about the treatment of these diseases. He used bromine preventatively and as a remedy. Goldsmith's early experiments consisted of mixing bromine and iodine with various animal poisons. He found that bromine "resisted the affects of animal poisons in their solid states and thus should be equally so in their gaseous states if vapor is suspended in the atmosphere."[186] He ordered surgeons to use bromine in wards wherever erysipelas and gangrene broke out. He was pleased with the results and observed that the "uniform testimony of the surgeons is that it is a perfect prophylactic to the disease." Hammond was particularly pleased to have the opportunity to test bromine as an "antidote to animal poisons." [187]In fact, Goldsmith's inspiration to conduct a trial using bromine topically came after reading Hammond's work related to his investigations in the treatment of poisoned wounds from the bite of a rattlesnake.[188]

What is perhaps most interesting about Goldsmith's report concerning the remedies for gangrene and erysipelas were his continued references to childbed fever. In the late 1860s, as Lister developed his methods for reducing infections in surgical wards, some physicians traveled to Lister's wards to observe his methods (midwives' bodies and clothes were exposed to sulphuric acid fumes, and hands and instruments were disinfected before and after deliveries.)[189]Physicians found that by adopting these measures, the mortality from childbed fever fell drastically. Lister's measures were similarly studied and applied by Johann Ritter von Nussbaum in the early 1870s during the Franco Prussian War in his gangrene ward.[190]But these developments came after the Civil War and it is of great significance that Goldsmith's work foreshadowed some of these discoveries.[191]Many physicians believed that erysipelas traveled through the

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[185] Ibid.
[186] Ibid.
[187] Letter to William Hammond from Middleton Goldsmith, Feb. 25, 1863. RG 94 (NARA) Medical Records, 1814-1919, D File, Box Three.
[188] Ibid.
[189] See for example, John Waller, *The Discovery of the Germ: Twenty Years that Transformed the Way we Think About Disease* (New York: Columbia University Press, 2002) p. 92.
[190] Ibid.
[191] He was not the first American to make this connection. Oliver Wendell Holmes published a paper after confirming the contagious disorder (puerperal sepsis) was spread by the mid-wife or attendant. Ignac Semmelweis demonstrated in 1847 that doctors and students going from the post-mortem room to the maternity ward led to the development of the disease. He thus recommended washing hands with disinfectant. But this work was largely ignored until Pasteur actually proved that deaths from puerperal fever were due to the streptococcus pyogenes organism (also the cause of

atmosphere, was inhaled and then entered the blood through the respiratory organs.[192]But Goldsmith wondered: if the poison acted from the blood, why did the disease select the face as the beginning point?[193]Furthermore, what could be learned about erysipelas by examining a woman during the "parturient state" and the relation to puerperal peritonitis?[194]He reasoned that a woman giving birth exposed to the miasm would likely develop puerperal peritonitis but that during the "non-parturient state" or after giving birth many women often escaped puerperal peritonitis. Why then did the miasm affect women during labor? He determined:

Her uterus is stripped of its lining epithelium; the internal surface of the uterus is like a piece of skin stripped of its epidermis. After this epithelial covering is reproduced, the parturient woman is no longer any more liable to the invasion of erysipelas than she was before she became pregnant.[195]

He did not see how the disease resulted from the blood. He then compared his theory with Civil War patients:

Expose a hundred men to the miasm of erysipelas; a certain number will have erysipelas of the face, the disease always commencing in the eyelid, the alae of the nose, or behind the ear. The disease commences in no other part of the body; it does not attack the trunk or extremities. But if wounds or abrasions exist, the erysipelas no longer selects the face, but attacks with discrimination of region, the parts wounded or abraded—provided only that the parts thus wounded or abraded are uncovered.[196]

He further found that men were more liable to attacks while in the crowded hospitals, but by protecting the face or open wound with "tinct. of iodine" or by "frequent application of glycerin, simple cerate or resin ointment" the tendency to develop new attacks almost disappeared. He adopted the same idea as Lister: to keep airborne germs away from open wounds. He suggested that based on the facts regarding erysipelas, that it must be some sort of contagion that acted "by contact with the skin"; that the contagion floated in the atmosphere and attacked a face with an uncovered wound.[197]Why the face? Because it was on the face that the "epithelium was thinnest," though he also suggested that wounds

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erysipelas). See, Irvine S. Loudon, "Childbirth" in *Companion Encyclopedia of the History of Medicine* Bynum, W.F and Roy Porter (eds) (London and New York: Routledge, 1993) pp. 1050-1091 (p. 1055-1061).
[192]Goldsmith, p. 8.
[193] Goldsmith, p. 8.
[194] Ibid. p. 10.
[195] Ibid.
[196] Ibid.
[197] Ibid. p. 13.

on the hand could engender an attack as well.[198]Similarly when the material surface of the uterus was opened, the woman was similarly at risk of the contagion.[199]He challenged medical men to re-investigate the "accepted theory" that diseases were simply products of the blood and that perhaps there was some kind of influence to consider, which acted locally. The experiences with these diseases demanded reflection on both the nature of these diseases but also on "ancient dogmas" as Goldsmith noted.[200]In other words, perhaps the changes in the blood were the result of the disease which was caused locally, rather than a disease that had physiological origins.

His impressions about the local nature of the disease did much to stimulate his management of the diseases. He began with the "experimental use of bromine" both as a prophylactic and treatment.[201]In November, 1862 Goldsmith ordered Benjamin Woodward to "procure bromine and use its vapors in all of the wards and watch its effects."[202] Woodward began by placing bromine in empty quinine bottles in all the wards, "enough to make its vapor very perceptible."[203]He repeated this daily and noted that "within 24 hours I saw a marked change for the better in all the patients since not one had died in the barracks from this disease except the one who was in the last stages of typhoid fever."[204] Woodward further remarked that "no cases of erysipelas had originated in the wards since the bromine was used."[205] Woodward wanted to confirm the results of the perceived value of bromine so he decided to "test the value of the article still further." He conducted an experiment in which he took a man who was suffering from erysipelas in the leg, "supervening in the wound and made him hold the naked limb over a chamber vessel in which was bromine and thus bathe it with the vapor." Woodward continued this twice a day and noted in his report that to his great satisfaction, "though sloughing was eminent, the disease was arrested and the man made a good recovery."[206]He concluded

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[198] Ibid.
[199] Ibid.
[200] Ibid. pp. 13-14.
[201] Goldsmith, p. 23.
[202] RG 94 (NARA) Medical Records, 1814-1919, D File, Entry 235. "Special Report on the Use of Bromine in preventing the spread if Erysipelas" to J.T. Head, medical director of hospitals in Louisville, from Benjamin Woodward, 22nd Illinois Volunteers, Nov. 15, 1862.
[203] RG 94 (NARA) Medical Records, 1814-1919, D File, Entry 235. "Special Report on the Use of Bromine in preventing the spread if Erysipelas" to J.T. Head, medical director of hospitals in Louisville, from Benjamin Woodward, 22nd Illinois Volunteers, Nov. 15, 1862.
[204] Ibid.
[205] Ibid.
[206] Ibid.

that though the use of bromine in this way was new to him he believed that its introduction into the wards of hospitals would be a "step towards the advancement of medical science." It was common during the war to invoke specific ideas about cleanliness that had dominated in the pre-bacteriological era such as opposing overcrowding, eliminating stagnant water and spoiled food, burying excrement, isolating those suffering from infectious diseases; however, the study of hospital gangrene and erysipelas foreshadowed the importance of using antiseptics to kill germs in the hospital setting.[207] Woodward recommended that in the event of "hospital gangrene, especially after amputating, and erysipelas supervening on wounds, the vapor of bromine brought in contact with disease may be the means of its arrest."[208] He believed that gangrene and erysipelas were the result of "poisons" which based on the repeated experiments that he and his colleague Professor Daniel Brainard of Chicago[209] performed respectively showed conclusively "that iodine [which is chemically alike to bromine] neutralizes all known animal poisons."[210] It is interesting that he recommended using bromine in the hospitals especially during and after surgery. He did not adopt these measures with the knowledge that he was suggesting ways in which surgical rooms could be kept "germ-free." Before the development of bacteriology, discussing "germs" in the context of disease vectors was unknown; however, Woodward was in fact advocating asepsis, paving the way for the acceptance of Lister's discoveries. This would become more pronounced as the experiences with various remedies developed during the war.

In March of 1863 Hammond sent Brinton to "the different general hospitals in Louisville and Nashville to examine the character, and incidence of the diseases and the "different modes of treatment employed."[211] Brinton visited the principal military hospitals with Goldsmith, and "carefully examined the various cases of hospital gangrene

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[207] It also foreshadowed Lister's famous discovery of antisepsis, the method he invented to kill germs during surgical operations, which entailed applying chemicals to the body. Of course the situation was different, but the idea of killing germs to prevent infection or the further spread of the disease was the same.

[208] RG 94 (NARA) Medical Records, 1814-1919, D File, Entry 235. "Special Report on the Use of Bromine in preventing the spread if Erysipelas" to J.T. Head, medical director of hospitals in Louisville, from Benjamin Woodward, 22nd Illinois Volunteers, Nov. 15, 1862.

[209] Brainard had found in his researches on the bites of rattlesnakes that iodine mixed with the virus destroyed its activity and had shown that like effects were produced upon other animal poisons. See Goldsmith, p. 23

[210] RG 94 (NARA) Medical Records, 1814-1919, D File, Entry 235. "Special Report on the Use of Bromine in preventing the spread if Erysipelas" to J.T. Head, medical director of hospitals in Louisville, from Benjamin Woodward, 22nd Illinois Volunteers, Nov. 15, 1862. He believed it could kill all animal poisons except canine ones.

[211] RG 94 (NARA) Reports of Diseases and Individual Cases, File A, Entry 253. By order of William Hammond March 28, 1863.

and erysipelas therein contained."[212] He remarked that the gangrene was the same that he had studied while in Annapolis though not as virulent, which he believed was likely due to the remedies employed rather than the "original character of the affection." Brinton discussed two stages of the disease: the period of progress (as the infection spread) and its reparative stage. He studied the shape of the ulcers, the slough and the nature of the sores which generally "burrowed deeply and extend rapidly" (as blood and tissues became decayed) in its period of progress. The most efficacious treatment, Brinton reported, is that which was "originated and introduced by Surgeon Goldsmith," consisting of "the direct local application of bromine, either pure or in solution to the surfaces of the sloughing sore."[213] As part of these investigations field physicians were instructed on how to administer bromine. They were advised to "remove as thoroughly as possible the sloughs, oily matter and flakes so that the agent may act on the living tissues, and permeate them to some extent."[214] In cases where the disease was "burrowed" and thus "deep seated" it was common practice to resort to hypodermic injections of bromine at the circumference of the sore. The idea was to ensure bromine could penetrate "the infecting cavities of substances which by strong coercion, arrest the putrefactive motion, destroy the products of putrefaction, and render putrescible substances non-putrescible."[215] In these cases Goldsmith demonstrated to Brinton (and others) that the punctures with the point of the syringe must be made "at intervals from one half to three fourths of an inch, and one drop of bromine is thrown into the tissues at each application."[216] Brinton was impressed by the treatment; "from my observation of the immediate effect of the regent diseased tissues and of the condition of the sores upon which it had been previously applied, I am inclined to look upon the remedy as one of great value and well deserving of a fair and extended trial."[217]

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[212] RG 94 (NARA) Reports of Diseases and Individual Cases File A, Entry 253 "Report on the Prevalence of Hospital Gangrene and Erysipelas in the Cities of Louisville and Nashville and on the treatment adopted." April 16, 1863 J.H. Brinton to W. Hammond.

[213] Ibid. Sometimes he used a solution of 10 parts bromine, 10 parts water, bromine potassium, 21/2 parts in solution.

[214] RG 94 (NARA) Reports of Diseases and Individual Cases File A, Entry 253 "Report on the Prevalence of Hospital Gangrene and Erysipelas in the Cities of Louisville and Nashville and on the treatment adopted." April 16, 1863 J.H. Brinton to W. Hammond

[215] Goldsmith. p. 44.

[216] Ibid.

[217] RG 94 (NARA) Reports of Diseases and Individual Cases File A, Entry 253, J.H. Brinton to Hammond "Report on the Prevalence of Hospital Gangrene and Erysipelas in the Cities of Louisville and Nashville and the Treatment Adopted." April 16, 1863.

With the use of bromine, Goldsmith argued that the specific character of any sore resulting from hospital gangrene could be destroyed. Goldsmith primarily focused on local remedies and as Brinton observed, "From conversations with Surgeon Goldsmith, I inferred that he regarded hospital gangrene as essentially a local affection; and that as soon as a decided local impression is produced upon the sore; all danger to life is averted."[218] Evidence for this was Goldsmith's primary focus on destroying the "poison" and diseased tissue so that healthy granulation could develop. He suggested that it was crucial to isolate the disease before it could spread. In other words, if the disease was confined to the sore and not allowed to spread to the cellular planes, muscles, tendons and bones into the deeper tissue, than the eradication of the disease was more likely. Goldsmith saw the disease form as some kind of invasion that had to be arrested before it could penetrate the body:

> It will be seen that the disease was developed in sores, small and nearly healed, as well as those which were extensive and recent; that in one case especially, it was developed at the sight of a purpurie extravasion, and that in another it invaded at a point almost cicatrized. It invaded wounds recent, wounds granulating, and wounds ulcerating. In some few of the cases the disease could be traced to no contagion; in others it was distinctly traceable to the presence of the disease in other patients. That the disease, when developed was contagious is shown by the occurrence of several cases in the beds next adjoining those already affected.[219]

Importantly, he also found that gangrene was a specific disease that "presented some constancy in most of their characteristics."[220]Goldsmith further argued that the constitutional state existing "at the time of the invasion, did not seem to have much liability to the disease; for the latter seemed to invade the strong and the feeble, the young and the old, the sick and the well with equal facility." He observed that "the disease could in no case be said to have a constitutional origin" and that he did not see one case in which the "constitutional symptoms precede the local disease."[221]Brinton agreed with much of Goldsmith's assertions regarding the nature of the diseases with the exception of its purely "local nature." He suggested to Hammond that since many of the cases of gangrene occurred in patients who had been wounded at the Battle of Murfreesboro,

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[218] Ibid.
[219] Ibid. p. 26.
[220] Goldsmith, p. 24.
[221] Goldsmith, p. 28.

retained in crowded hospitals, then transported in "crowded poorly ventilated boats" and exposed to the "influences apt to engender this disease" while on route to Louisville, it must be considered to be both a local and constitutional affection.[222]

But Goldsmith's use of bromine as a remedy against hospital gangrene and erysipelas, and his encouragement to his peers to adopt the remedy, supported some interesting discoveries about the pathology of these diseases. He discovered that cases treated with bromine had a "rapid subsidence of the symptoms of infection."[223] Indeed, physicians increasingly saw that gangrene and erysipelas were distinct disease entities, which attacked indiscriminately and seemed to invade the body from without, but once the local causes were arrested, pyemia or further physiological debility was often avoided. For example, the physician H.R. Nooke, General Hospital No. 11, Louisville, Ky, noticed that when pure bromine was applied directly to the wound the sloughing almost immediately ceased, along with the "fetid odor" and the "dead portions began to detach themselves"; most importantly, "within thirty six hours, the pyemic symptoms began to close."[224] The key finding was that the diseases were local, but a local disease could produce constitutional symptoms. Thus Goldsmith encouraged physicians not to focus on the interiority of the patient but rather on the disease entity at the local level. Pyemia proved more difficult to understand. Goldsmith suggested that it was the result of a local wound that spread or had become infected and, as the accepted theory went, "patients by breathing a poisoned atmosphere acquire a constitutional or blood state, eventuating in if not consisting of pyemia."[225]He associated the cause of the disease not with an aberration of cells or a physiological abnormality but rather an infection caused by the same matter that caused erysipelas:[226]

> Now it is a singular circumstance to begin with, that no one has pyemia who has not somewhere in his body, infiltrating tissues, filling cavities, or flowing from wounds or their equivalents, animal fluids whether regarded as exudates without morphological change, or in the form of cell-bearing liquors. Again it is within the knowledge of every medical man that pyemia may occur independent of suppuration, in connection with

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[222] But because many organisms were working together to produce this strain of gangrene it could cause a different clinical course between patients, which likely contributed to these debates.
[223] RG 94 (NARA) Medical Records, 1814-1919 D File, Box 15 Entry No. 193. Letter from Goldsmith to Brinton, March 17, 1863.
[224] Report submitted by H.R. Nooke and reprinted in Goldsmith, p. 59.
[225] Goldsmith, p. 43.
[226] The staphylococcus bacteria formed pus organisms in the blood to produce pyemia. It had constitutional symptoms such as fever, chills, nausea.

pathological processes where the warmest of Virchow's admirers fail to discover any cell growth or cell-differentiation; nay, more, pyemia is more constant to such collections as are found in exquisite erysipelas, where the purulent fluids yield to the most searching investigation neither cells, nor nuclei, nor nucleoli—nay not even a connective tissue, corpuscle, or any morphological structure; and that seemingly, just in the degree that the morbid products approach the standard of true pus the danger of pyemia grows less.[227]

He did not understand the behavior of the disease so he suggested a simple theory of absorption.

....in some diseases, THE GRAVAMEN OF THE CONSTITUTIONAL STATE, IF NOT ITS TOTALITY, IS PLAINLY DUE TO THE ABSORPTION OF THE PRODUCTS OF THE LOCAL PROCESSES.[228] I say, absorption; for it is not possible to conceive of any other processes by which the whole organism could be involved to the extent noticed.[229]

He encouraged other researchers to concentrate on the issue since the observations may have had a wider significance for the transmission of all diseases. He concluded by noting that his "observations lead me to think it is one of broader significance and wider application than is generally believed" and he suggested that he did not want to challenge beliefs but rather "invite investigation."[230]But Goldsmith well illustrates the climate in which Civil War medicine developed. There was an emphasis on mastering both the unfamiliar and familiar but also developing medical knowledge:

If the projected law is a true one, the effect would not be to revolutionize but to simplify; to give precision to methods now vaguely used; to give definite views and purpose to remedial measures; to draw attention to the completeness in the effect of traditional remedies; to supplant surmise with faith, and indecision and doubt with confidence.[231]

The most pronounced effect of his investigations, however, was in the development of bromine for the treatment of gangrene and erysipelas. Medical Inspector S. Humphreys observed of Goldsmith's methodology in these types of cases:

The application must be well and thoroughly made so as to reach all parts of the gangrenous disease. The locality of bromine in reaching the gangrenous and erysipelatic

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[227] Goldsmith, p. 43.
[228] His emphasis.
[229] Ibid. p. 44. From mid-century and well into the late nineteenth century physicians spoke of "autoinoculation" or "autointoxication" absorption of the "products" of wounds then infecting the body. These theories were also developed in the bacteriological era as physicians debated whether disease could be caused by the absorption of breakdown products of intestinal bacteria. See Bynum, p. 130.
[230] Goldsmith. p. 45.
[231] Ibid

surfaces and cavities under the cellular and muscular tissue and no doubt much of its antiseptic and catalytic effects are from isolation and absorption.[232]

As Benjamin Woodward reported in the case of his patient William Boyer, "Every part was subjected to the action of bromine, and the sinus injected in its whole length. When he was admitted his death was considered certain, but the progress of the disease was arrested and now the wound is only three and a half inches long by one inch wide, and filled nearly to the surface with healthy granulations."[233]Physicians listened to Goldsmith's advice and saw the efficacy of bromine but also the local nature of the diseases, changing their basic assumptions about gangrene and erysipelas. As the physician John Octerlony reported, "it must be remarked that the constitutional symptoms underwent a marked improvement whenever the gangrenous surface was fully brought under the influence of bromine."[234]He further observed that "the symptoms of pyemia disappeared almost simultaneously with the arrest of the fetid discharge, and reappeared with the return of the latter."[235]It is significant that Goldsmith's report included cases compiled from more than one hundred physicians in the field. It was many investigators working together to create medical knowledge that could have immediate clinical relevance.

Goldsmith and Brinton also undertook extended studies of erysipelas while in Louisville. Hospitals number nineteen and twenty were set apart for the study of this disease. Their locations were chosen because they were originally country residences, "located on rising grounds and well ventilated and once sent thither strict isolation is enforced."[236]There were two hundred and twenty eight cases of erysipelas treated in Louisville; fifty-one died, while one hundred and twenty seven recovered.[237]Once again bromine was used to treat erysipelas and two different methods were employed in its application: "first by action of the vapor of bromine in the affected part" and second, "by

[232] RG 94 (NARA) Medical Records 1814-1919 D File, Box 15 S. Humphreys to Hammond "Effects of Bromine in the Treatment of Hospital Gangrene." Feb. 28, 1863.
[233] "Report of Cases of Hospital Gangrene, treated with bromine, in General Hospital 7, Murfreesboro, Tenn., from March 7th to April 27th by Ben Woodward, Surgeon in Charge" reprinted in Goldsmith, p. 66.
[234] Report on Gangrene submitted by John A. Octerlony, AAS USA, General Hospital No. 8, Louisville KY, Reprinted in Goldsmith p. 76.
[235] Ibid.
[236] RG 94 (NARA) Reports of Diseases and Individual Cases File A, Entry 253 "Report on the Prevalence of Hospital Gangrene and Erysipelas in the Cities of Louisville and Nashville and on the treatment adopted." April 16, 1863 J.H. Brinton to W. Hammond.
[237] Ibid.

a direct application to the erysipeletic surfaces of a solution of bromine of varying strength."[238] Brinton outlined the way in which each method was used:

> In the first method the part affected was enveloped by dry lint; a cloth saturated with pure bromine was then applied over this, and the whole dressing covered with a piece of oiled silk. The only objection to this treatment was the tendency of the bromine to blister the skin, by soaking through the intervening layer of dry lint. The other mode of using the bromine is to apply directly to the inflamed integument a solution of the bromine and bromide of potassium of the strength of from fifteen to forty drops of the former to the ounce of water.

After having been exposed to Goldsmith's work, Brinton was fully prepared to endorse further clinical trials with bromine:

> 1. That the external employment of Bromine in the treatment of hospital gangrene has been attended, in Louisville, with the most marked and beneficial results.
> 2. That I have not observed that any injurious consequences, whatsoever, have resulted from its application, but the contrary.
> 3. That all the medical officers with whom I have conversed with in Louisville, Nashville, Murfreesboro, unite in testimony as to the valuable therapeutic powers of bromine in the treatment of erysipelas; my own observations confirm their views. And it is eminently deserving of further trial.[239]

Perhaps bromine worked too well. Goldsmith concluded: "I am sorry that I can't send you any specimens of hospital gangrene for so far none have died."[240] Brinton remarked that "the results of the use of bromine in our hospitals are so marked and important that it would seem that they ought to be published or in some way brought to the knowledge of the surgeons in the service at an early period."[241] Goldsmith further suggested that the surgeons should be called together and told in detail "the nature of the diseases to be investigated as well as the way of investigating them," believing that these diseases provided an opportunity to train the "undergraduates" by members of the "senatus medicorum."[242] He noted in his report to Hammond:

> Before the occurrence of any cases in our hospitals, I had directed the surgeons in charge to procure bromine, so as to have it ready for use when the disease appeared. Many of the surgeons had no experience in the use of the remedy. They were imbued with the idea, prevalent in the profession, that this agent is a highly corrosive and

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238 Ibid.
239 Ibid.
240 Goldsmith p. 28.
241 RG 94 (NARA) Medical Records, 1814-1919 D File, Box Three Entry 250. Letter to J.H. Brinton from Middleton Goldsmith, March 8, 1863.
242 Goldsmith p. 29.

> irritating one; and hence they almost uniformly used it, in the beginning, largely diluted with alcohol, water or ether. The inefficiency of this use of the remedy, comparably with stronger solutions, or with the bromine in substance will be seen in the case histories....as the surgeon gained experience with the remedy they gained confidence in its efficacy and learned that it was not to be the corrosive and irritating agent which they had supposed it to be.[243]

It was significant that Goldsmith trained other physicians in his methods. He often traveled to a number of hospitals where he was compelled to "take the surgeon to the bedside, teach them the disease, what to observe, what to record, what to investigate, how to apply the remedy and to teach them the pathological processes."[244]He also employed a man "who can make tolerable drawings of microscopic objects" in his travels to the hospitals to be included in his publications for the *Medical and Surgical History of the War of the Rebellion.*[245]

Goldsmith also ordered surgeons that were engaged with the study of these diseases similarly to conduct field research relating to the work of their peers. In late 1862 Goldsmith ordered G.R. Weeks, U.S.V. to visit "all the hospitals in and around Louisville, and collect from the records and attending surgeons all the facts that have occurred in connection with hospital gangrene during the winter and spring."[246]Weeks examined the records of 115 cases of gangrene, visited the hospitals, "gleaned the facts" and "heard all of the evidence and conversed with the surgeons" and determined that with bromine there was a remedy "certain in its effects for the arrest of hospital gangrene, the greatest scourge of military hospitals."[247]He continued:

> This is I am aware strong language, but I think not more so than the circumstances and the evidence in the case warrant. I expect most confidently the future will verify what I am now saying. Bromine has robbed gangrene of its terror, and shorn its power to stalk through the wards where the sick and wounded are congregated, spreading its contagious and pestilential influence in every direction. But, armed as the surgeon now is by the use of a remedy so certain in its effects, a feeling of security pervades the entire profession at this post.[248]

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243 Ibid.
244 RG 94 (NARA) Medical Records, 1814-1919 D File, Entry 193 Letter to Hammond from Goldsmith March 22, 1863.
245 Ibid.
246 Geo. R. Weeks, "Report on Hospital Gangrene as Observed in General Hospital in Louisville, KY" in M. Goldsmith, "A Report on Hospital Gangrene, Erysipelas and Pyeamia as Observed in the Departments of Ohio and the Cumberland with Cases Appended" (Louisville, Bradley and Gilbert, 1863)
247 Ibid. p. 40.
248 Ibid. p. 40.

Being able to consult and compare the findings of numerous physicians was one of the most important ways that knowledge was produced and then transmitted during the war. Consultation allowed for the diffusion of the most up-to-date medical knowledge, including the means of prevention and treatment, and created a community of physicians devoted to producing new forms of medical knowledge that would benefit the soldiers.

But not all physicians were convinced by Goldsmith's devotion to bromine, particularly as a prophylactic. Private Caleb S. Anderson, Co. 7th, Virginia was admitted to Ward Two of the Satterlee hospital July 11, 1863 after being wounded by a minie ball entering his right heel at Gettysburg and treated by W.W. Keen. The bones in his foot were found to be badly shattered but the external wounds were "small and not much inflamed, but the pus is dark and oily."[249] The wound did well for two weeks until it "began to enlarge." Hospital gangrene appeared days later in the wound with constitutional symptoms following. He was isolated and administered quinine, tincture of iron, chloroform, beef tea, liquor and extra diet of chicken and beef broth. On August 11 the wound was cauterized and bromine was applied over the surface and in "every nook and corner followed it by wet lint." Keen noted:

> The bromine I am convinced is a poor agent… it is excessively painful more so than the acid nitrate of mercury or nitric acid…and few will apply it on account of the inconvenience of its nearly suffocating fumes which prevent a close inspection of the thoroughness of its application.[250]

Private Anderson's wound did not respond to bromine or to a flaxseed and yeast poultice, and the patient suffered, "his mind wandering" until he died, August 25. Keen preferred nitric acid or the acid nitrate of mercury (which he believed caused the least pain) and required no anesthetic to be used while administering the treatment. While their preferred treatment differed, Keen like Goldsmith believed that the constitutional treatment was of less importance than local since he often observed the decline of the constitutional symptoms after "the vigorous local treatment" was pursued. According to Keen, once local lesions improved the "fever would quickly decline," the patient would "feel, sleep and eat better" and "will attest that he feels first rate."[251]

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[249] RG 94 (NARA) Reports of Diseases and Individual Cases File A, "Reports of Surgical Cases at Satterlee Hospital."
[250] Ibid.
[251] Ibid.

Medical Inspector Frank H. Hamilton also had reservations about bromine and warned against what he perceived as careless behavior. He wrote to Hammond in April, 1863 complaining that as the sick and wounded men were brought from the front or sent to the general hospitals in Nashville or Louisville, they were sometimes "placed in wards already affected with hospital gangrene and erysipelas and that cases have come to our knowledge in which they have contracted these maladies, and we fear a good many have lost their limbs and their lives. We believe that this careless and indiscriminate reception of patients into gangrene and erysipelas wards has grown out of a belief in the prophylactic powers of bromine, a point that does not yet seem established."[252] But Goldsmith did not only use bromine as a prophylactic; he first advocated its direct use on the wound, and each stage of the wound had a different prescription. He observed that in cases of erysipelas, for example, where the "true seat of disease was in the cellular tissue," that "the vapor of bromine would have no influence in "preventing or arresting the disease unless the substance had been brought in contact with the suppurating surface."[253] In this type of case he recommended injecting a solution of bromine into the cellular planes and the necrosed bone in order to "treat any infecting agency."[254] Again some physicians objected to the use of bromine to treat gangrene and erysipelas when they had become "deep seated," feeling that creosote was the superior remedy.[255] But the idea was the same: to use a strong chemical to kill the invading disease. Local applications were considered efficacious if it was a suitable substance with the "chemical power of decomposing the specific virus of gangrene so that it no longer exists, provided it can be brought in sufficient quantities in direct contact with every atom of gangrene matter."[256]

By the end of the war more physicians were brought round to Goldsmith's viewpoint simply because it worked.[257] S. Humphreys, Medical Inspector, USA reported to Hammond that bromine had been used in all cases of gangrene and erysipelas

[252] RG 94 (NARA) Medical Records, 1814-1919 D File, Box 3. Extract of a Report Submitted to Hammond by Frank H. Hamilton, Medical Inspector, U.S.A April 30, 1863.
[253] RG 94 (NARA) Medical Records, 1814-1919 D File, Box 15. To Brinton from Goldsmith, March 17, 1863.
[254] Ibid.
[255] *Medical and Surgical History* Vol. II, Pt. III p. 837. Assistant Surgeon John E. Crowe of hospital No. 4, Louisville had marginal success with creosote (though he used bromine for superficial wounds.)
[256] Ibid. p. 846 from the report of C.H. Cleveland of Church Hospital, Memphis Tenn.
[257] Statistical analyses of patients treated with bromine demonstrated that patients undergoing a course of treatment with the agent often improved/healed completely under treatment. Please see appendix three.

occurring in Louisville and in "every instance the erosion of the disease and sloughs particular to hospital gangrene as well as the feotor (stench) have been promptly arrested together with marked improvement in the constitutional symptoms."[258]He was pleased with the effects:

> I have examined most of the cases of hospital gangrene in the various hospitals in from two to four days from the time the bromine treatment was commenced, the whitish ole-composing, pulpy animal matter constituting the sloughs was thrown off and well formed granulations resulted. By the occasional use of the bromine solution to the surface of the excretions, all further extension of the disease is prevented. Combined with the bromine applications are good nourishing diet, tonics and stimulants.[259]

Assistant Surgeon C.H. Cleveland after having conducted trials with nitric acid, sulphate of zinc, acetic acid, chloride of zinc, persulphate of iron and chlorinated soda found that "bromine in its full strength is the agent which has given us the most satisfaction.[260]Indeed, as Goldsmith similarly pointed out:

> No cases treated in these hospitals are isolated; they are treated in the midst of other wounded men. When the bromine is promptly and thoroughly applied, the disease does not spread. In the beginning, and before the bromine was used promptly and efficiently, a few cases were produced by contagion, but not one after we got into the habit of using the remedy in the way we have now settled upon. In one of the hospitals two cases were brought into the house with the disease full-fledged. A man in the next adjoining bed took it; another directly across the ward took it; the weather was cold, the ward was small and ill-ventilated, and all the inmates were wounded. After the bromine was used, no new cases occurred. So strongly are our surgeons impressed with this application of bromine, that they have lost all dread of hospital gangrene spreading in their wards.[261]

Though Goldsmith approached the treatment of the disease as a "thing" to be destroyed, his thinking on the matter was far more complex. Examining Goldsmith's case reports through the war years reveals the complexity of the period to ideas about disease causation. He began his work believing the diseases to be of a primarily miasmatic nature, he then adopted Virchow's doctrines, which supported the idea of disease an internal malfunction of cells (which he reconciled with zymotic theory), and then shifted

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[258] RG 94 (NARA) Medical Records, 1814-1919 D File, Box. 15 Entry 261. Report submitted to W. Hammond from S. Humphreys, Medical Inspector USA "Effects of Bromine in the Treatment of Hospital Gangrene," Feb. 28, 1863.
[259] Ibid.
[260] *Medical and Surgical History* Vol. II, Pt. III, p. 846 From the report of C.H. Cleveland, of Church Hospital, Memphis Tenn.
[261] Goldsmith, p. 32 In fact, the Medical and Surgical History records only 135 cases of hospital gangrene from July 1864 to June 1865 as compared to the year earlier in which 1611 cases were reported. See, *Medical and Surgical History*, Section I, Vol. 3 p. 825

once again to a more ontological assumption about disease causation, or that the disease was due to some kind of specific contagion (the opposite end of the zymotic spectrum). It was common in this period for disease theories to overlap and he often referred to these three theories as one general theory. This was probably due to the uncertainty of disease causation, or because of the conflicting evidence physicians saw in their investigations, which challenged traditional beliefs about disease. But, many physicians eventually favored local causes of these diseases and thus treated the diseases as a "thing" something that needed to be countered or destroyed by the chemicals employed, which was important in laying a foundation for both contagion and ontological assumptions of disease to develop. But purely ontological support for treating these diseases was not standard practice yet; the move toward it was more complex. Case reports relating to these diseases illustrate that while physicians saw these diseases as the result of some local cause or contagion, many physicians also still believed in the idea of a "vulnerable constitution." As a result of this work, however, more contagionists suggested that individual predisposition was an outmoded idea. The case reports clearly show that these diseases were thought to be some kind of entity and not merely a generalized disorder of the body. The idea of a "contagion" was thus crucially important in leading to new ways to manage disease environments—both to keep hospitals clean but also to prevent the eruption of disease in the first place. The experiences with these diseases played a pivotal role in shaping disease theories and policies around their management, ultimately garnering support for bacterial theories of disease later in the century.

Preventative Medicine during the Civil War:

Bacteriology as a branch of medicine was unknown during the Civil War; however, while physicians did not yet make a connection between disease and microorganisms, it became common practice strictly to enforce sanitation measures in the new hospitals. The most significant achievement in the investigations into these diseases may have been their stimulus to the development of preventative measures in the hospital setting, which ultimately provided overwhelming evidence for the contagiousness of these diseases. There had been a long battle between contagionists and anticontagionists[262] but this had been more about the role of government in regulating business and ordering quarantines than about disease theories. Prior to the war, there was also a lack of cohesiveness among physicians in what they saw and studied and how they practiced. But during the war the evidence related to these diseases accumulated, creating a record rooted in common experiences and observation. Most of the case reports reveal that doctors adopted a "contingent-contagionist" position: that there was a poison but susceptible individuals were at a greater risk (which could be exacerbated by climate, crowds and poor ventilation), placing importance on preventative medicine. Sanitary movements were not new, having been used by health reformers and contagionists during the cholera outbreaks and to improve the conditions of row housing and factories; but poor hygienic conditions among the poor and in hospitals prior to the war was still commonplace.[263]But the war years were quite different; the men exposed to diseases contracted in crowded or risky environments were courageous young men fighting to preserve the Union. The medical profession had a responsibility to create safe environments for the soldiers, and the public's intolerant views of the regular medical profession, or differing beliefs about disease transmission, needed to be overcome so that the hospital setting could be made safe.

As hygiene movements swept across Europe in the 1850s, including the creation of new schools of hygiene, improved water supplies and sanitary movements in factories, the Civil War also proved a stimulus for the improvement of hygienic conditions. John Duffy has suggested that the "American Civil War marked a watershed in the history of American public health"; that the war helped "usher in the sanitary revolution, and it was followed immediately by the appearance of the first effective municipal health departments and the beginning of the state boards of health."[264]He suggests that advances

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[262] Anticontagionists believed in the existence of decomposing organic matter called miasma that would thrive in certain atmospheric conditions including filth, and a person with a constitutional predisposition was at greatest risk. Usually some kind of noxious effluvia would be exhaled and then inhaled through the lungs entering the blood, disrupting the physiological balance and a new case of disease would develop in someone with a predisposition. Contagionists on the other hand believed that the disease causing matter was produced in the bodies of sick people, transmitted by exhalations and inhaled by healthy people who then became sick (thus traceable to human contact).
[263] For the best synthesis on the development of public health see, George Rosen, *A History of Public Health* (The Johns Hopkins University Press, Baltimore, 1992). Chapter 6 and 7 relate specifically to the mid-to late nineteenth century. Charles Rosenberg, *The Cholera Years: The United States in 1832, 1849, 1866* (The University of Chicago Press, Chicago, 1962) p. 150.
[264] John Duffy, *The Sanitarians: A History of American Public Health* (University of Illinois Press, Chicago, 1992) p. 126. See also Judith Walzer Leavitt, "Public Health and Preventative Medicine" in *The Education of American Physicians: Historical Essays* (ed) Ronald Numbers (The University of California Press, Berkeley, 1980). Leavitt

in the basic sciences such as pathology, physiology, chemistry and histology provided important insights into disease processes and "set the stage for the bacteriological era."[265] This was true in the investigations into hospital gangrene and erysipelas. But there is another crucially important dimension to consider. As hospitals sprung up and developed during the Civil War, and more physicians than ever worked in them, they literally saw the communicable nature of these diseases. Physicians had had enough experience with these diseases to know they were contagious diseases and therefore adopted measures to prevent their spread:

> Hospital gangrene is produced by infection upon an exposed surface. A man acting as a nurse to his captain who had gangrene, had small spots of inflammation on his ankle, caused possibly by mosquito bites, which he had rubbed the skin from; he also had little scratches on his fingers; gangrene set in at all these points, and he may yet lose his life as a result.....Instances have occurred in this hospital where wounds which had been free from gangrene for several days became again diseased, and doubtless from renewed infection received from others laboring under the disease. To guard against infection we have made free use of chlorinated soda, chloride of lime, a solution of permanganate of potassa, chlorinum and bromine and the most scrupulous cleanliness and free ventilation. Each patient is supplied with his own drinking cup and other utensils, and his own sponges; if he has two wounds and only one is gangrenous, each wound has its own sponge, and all are kept as clean as possible. If the nurses or surgeons have wounds or abrasions on their hands, bromine is applied and their hands exposed to the virus without fear.[266]

Although these public health measures were initially institutionalized within the military setting (which did not generally yet affect American civilians), a more complex hygienic model emerged during the war, setting the stage for future developments in public health. Case records provided important intellectual support for the development of sanitary science. During the war it was more than simply campaigns against dirt and overcrowding (which generally drove sanitary movements); rather the measures employed were driven by the facts that had accumulated about these diseases: they were contagious, they seemed to attack indiscriminately although individuals did vary in their susceptibility, and there were many remedies that had proven effective in

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similarly suggests that "the Civil War turned the attention of medical colleagues to public health. The Union Army required its medical staff to attend lectures in hygiene, and medical schools responded by establishing such courses and hiring professors to teach them." p. 251 She further suggests that "the Civil War had demonstrated the practical importance of public hygiene and the lesson was easily applied to urban areas after the war." p. 253.

[265] Ibid.

[266] *Medical and Surgical History* Vol. II, Part III p. 848 From the report of C.H. Cleveland, of the Church Hospital.

managing these diseases. Further, there was now a dialogue about "disease poisons," some of which had been seen under the microscope. Disease was no longer unmanageable and to a considerable extent this changed the physician's perception and relationship with disease. These varying theories helped the development of a more medically sound but complex sanitary movement, based on science, borne out of the evidence of thousands of cases, which were then recorded for study. The fear of "loss of liberty" generally associated with government attempts to enforce public health was not present in the military hospitals. Indeed, physicians took extraordinary measures to prevent the spread of these diseases, which were necessary to help the troops recover quickly and return to active duty, and also to ensure that uninfected patients were not put at risk.

The Assistant Surgeon R.Weir, General Hospital Fredrick, Maryland recommended a number of measures for preventing the spread of hospital gangrene:

> Hospital Gangrene the typhus of wounds may be regarded as a species of moist gangrene, characterized by its contagious and infecting nature and due to a peculiar poison of as yet unknown origin. I shall endeavor as briefly as possible to present a history of it as it appeared in the USA general hospital now under my charge. If it is proper to premise that the entire hospital was at the time much crowded with severe cases of wounded men brought in from the battle field of South Mountain and Antietam Sept 14-17, 1862 and that both prior to, and since, the outset of hospital gangrene, the utmost attention was given to cleanliness and ventilation. No dressing or bandage was permitted to be used a second time but was taken from the wound. Oakum was also largely used; and to each patient was given a new sponge which was frequently and thoroughly cleaned and always kept in view at the head of the bed; and nurses were required to wash their hands frequently in sol sodae chloride before visiting any other patients.[267]

Rather than elaborate the ravages of the disease, which he felt had been "frequently and ably described by other military surgeons," he traced the epidemiology of the disease hoping to reveal a pattern and offer a deeper understanding of the spread of this disease. He traced the first case as being on October 15, 1862 in barrack E. A second patient was admitted from Turney Hospital with gangrene and was placed in barrack C. He then noted that since these two cases the disease "has made its appearance in every one of the hospital buildings."[268] Weir noted in his report that the barracks B and E were erected for

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[267] RG 94 (NARA) Reports of Diseases and Individual Cases File A Entry 288 "Remarks on Hospital Gangrene" From USA General Hospital Frederick Maryland, R.F. Weir, March 1863.
[268] Ibid.

temporary occupation only to accommodate the overflow of patients arising from battles in the Shenandoah Valley. He felt they were defective in ventilation, offered poor circulation and that the space allowance for each man was insufficient. He suggested, however, that ventilation and space would not alone deter this disease. He showed its infectious nature by tracing its spread through barrack F, which was "a new building, 150 feet long, 30 feet wide and 20 feet high at the ridge in which 64 patients were allowed 1250 cubic feet of space with excellent ventilation." Two cases occurred, the "second one having been produced by the accidental use of the sponge belonging to the patient first affected:

> Not only did the disease spread throughout the hospital, but the surgeons and attendants became infected by it the poison having been introduced in some slight abrasion on Assistant Surgeon North to whose charge the treatment of most of the cases of hospital gangrene was given, contracted the disease; in his own case and those of the attendants the sharp stinging pain first attracted attention and only after the local symptoms had fully developed themselves did the constitution give evidence of the disease.[269]

He was able to develop a comprehensive picture of the disease based on his epidemiological analysis, including its pathology:

> Of the 60 cases in which this disease has been observed it has been noticed that only cicatrizing wounds were attacked although operating were of daily occurrence and that in but 7 cases where the local manifestations were preceded by constitutional symptoms. In 47 cases the constitutional symptoms followed the sloughing and in six cases these were now present during the entire course of the disease. Thus showing 53 cases in support of its local nature.... In reference to this point the opinion formed from the cases observed in this hospital and also those met with in the NY city hospital during my service as resident surgeon in that institution is in favor of it being a local disease.[270]

He developed a fairly sound understanding of the disease and recommended that it must be handled meticulously. He advised using bromine prophylactically along with ventilation, clean dressings at least every two hours, washing the sheets and clothes of infected patients separately, that the barracks be "systematically cleansed, disinfected and whitewashed" and remedying the over-crowding by transferring patients to other hospitals.[271]

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[269] Ibid.
[270] RG 94 (NARA) Reports of Diseases and Individual Cases File A Entry 288 "Remarks on Hospital Gangrene" From USA General Hospital Frederick Maryland, R.F. Weir, March 1863.
[271] Ibid.

Hammond also asked Medical Inspector W.P. Mussey to examine an outbreak of hospital gangrene at the general hospital at Judiciary Square in May of 1863 after an influx of patients was received into the hospital. It is significant that his long report was almost entirely devoted to sanitary recommendations. Almost immediately, Mussey and the hospital's assistant surgeon, Albert Hartsuff, began cauterizing the wounds with bromine (either full strength or diluted with water depending on the severity of the wound), followed by applications of water dressings, extra full diet, whiskey and opium.[272] He also directed that patients be given a "generous administration of fresh vegetables and fruits" as a prophylactic and to "shorten the period of convalescence." He ensured that chloride of soda and lime was used to disinfect the wards, had the privies that were connected with the common sewer of the city closed, the walls of the building and doors whitewashed and sanitary police employed. He also ordered "the whole extent of the wall and the roof thoroughly lime washed" and the "wall scrubbed, to which he proposes to apply a disinfectant."[273]Mussey proposed ideas about ventilation (from both the side wall and the roof), even recommending reconstructing the hospital along more hygienic lines. The move towards preventative medicine consisted largely of the use of antiseptics and building improvements in hospitals (which focused on ventilation and location). Because these measures could be seen working during the war they did much to garner support for sanitary science. Significantly, physicians were accountable within the military structure in a way that had not been prior to the war. As Silas Weir Mitchell observed of the hospital inspections precipitated by erysipelas:

> This moved with strange rapidity from bed to bed in the ward, generally following the direction of the wind as it blew through the room. Hospital inspections—no matter how remote the hospital they were subject to frequent ruthless inspections, when a trained man unexpectedly appeared at midnight or in the day, spent 24 hours in seeing everything in the hospital, and then with praise or blame sent to the Surgeon General reports which spared no one high or low. See John Shaw Billings admirable little handbook of hospital management. I saw the experiment tried in Philadelphia in a great hospital. It was not very much liked, but to the bewilderment of a previously well satisfied board of clergymen, it brought before them nine pages of humiliating revelations.[274]

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[272] RG 94 (NARA) Medical Records, 1814-1919 D File "Report on the Possible cause of the Prevalence of Hospital Gangrene at Judiciary Square" For Hammond by W.P. Mussey, Lieutenant Colonel, Medical Inspector USA June 3, 1863.
[273] Ibid.
[274] Silas Weir Mitchell, "The Medical Department in the Civil War: Address before the Physicians Club" Chicago, Illinois 1902/March/25. Library of the College of Physicians, Philadelphia, Box 17, Series 7.

In their investigations related to gangrene and erysipelas, doctors had seen the practical importance of hygiene in the hospital setting, which supported their scientific discoveries. These findings were reported upon and published, and it was soon perceived as necessary to enforce cleanliness in the hospital setting.

The use of bromine was found particularly effective in the hospital setting and, as suggested above, was found to work by a growing number of physicians. Goldsmith, for example, suggested that the vapor of bromine consistently prevented the spread of erysipelas in the hospital wards.[275]He developed a solution (which was poured into deep vessels and empty quinine bottles in a dry room) consisting of one to two ounces of bromine, 160 grains of bromide of potassium, distilled water, enough to make four fluid ounces of the entire mixture. He advocated keeping the odor of bromine constantly present in the hospital wards. Benjamin Woodward similarly noted:[276]

> While erysipelas was in every ward of the Parks Barracks Hospital, under my charge, and one ward was full of erysipelas patients, and from which several died, I was ordered by Assistant Medical Director Goldsmith, to procure bromine and use its vapor as a prophylactic, and watch its effects. This I did at first by dropping bromine into bottles and placing them in the wards, and especially near the erysipelas cases....In most of these cases there was an immediate arrest of the disease, and gradual in all. Not another case originated in the wards while the bromine was used.[277]

Once again Goldsmith invited other physicians to conduct "the experiments necessary to test the question" of the prophylactic powers of bromine for managing erysipelas. It was simple: all that was necessary was to "liberate so much of the vapor of the bromine as is sufficient to make its odor obvious in the infected wards" which were to be kept "as dry as possible."[278]Importantly, however, they were not merely advocating cleanliness but rather how to prevent infection from arising in the first place. Gangrene and erysipelas posed a serious medical problem and the use of bromine as a prophylactic had immediate and significant clinical relevance. Without the specific knowledge of asepsis, these newer

[275] RG 94 (NARA) Reports of Diseases and Individual Cases File A, Entry 290, Box 18 Letter from Goldsmith to Hammond regarding the use of bromine for gangrene and erysipelas.
[276] This report was first read before the Louisville Society of Army Surgeons which nicely illustrates how the medical environment of the war stimulated both new knowledge and the transfer of this knowledge so that other physicians could practically test the results. He believed the bromine worked by antagonizing certain animal poisons.
[277] Ben Woodward, "Report upon the use of Erysipelas, read before the Louisville Society of Army Surgeons" reprinted in Goldsmith, p. 82.
[278] Goldsmith, p. 84.

concepts were blended with traditional concepts of antiseptics to manage these diseases. Bromine was released into the air, dressings were treated with antiseptics, patients were doused with antiseptics, nurses were ordered to wash their hands in chemical solutions and hospitals were thoroughly sanitized. Civil War physicians recognized that if they acted swiftly and cautiously these diseases were treatable, even preventable, placing a new responsibility on the doctor.

During the war there were many theories, debates and differing opinions which had developed in regard to hospital gangrene and erysipelas; however, these various threads were not pulled together until years later when the laboratory work in Europe helped give shape to these investigations. But the study of medicine changed for many physicians during their investigation into these diseases, and these changing attitudes regarding disease management would pave the way for the developments in bacteriological science in the later nineteenth century. There was no name, for example "germ theory," to coalesce around; but public health measures nevertheless were stimulated in the hospitals to ensure that these diseases were not transmitted to patients who needed to recover and return to the front. Physicians debated whether these diseases were the result of local causes; perhaps a poison that was easily spread through a sponge, others held they were due to atmospheric conditions, while still others suggested that it was a combination of the two factors, or an internal malfunction. The investigation into gangrene and erysipelas left an interesting record of work that illustrates the vitality of medicine in this period related to the varying disease theories, and most physicians were actually quite open-minded with regard to their investigations. The case reports show that it was both a dynamic and complex period with many ideas emerging about diseases: the diseases appeared to be contagious, individual patients suffered common symptoms and there were common features established about the pathology of gangrene and erysipelas, though the diseases could vary in virulence from person to person, campsites and locales. Different factors such as the constitution of the patient, his attitude, the conditions in which he was wounded or transported, the climate, and food he consumed were all factors in creating a picture of these diseases suggesting that the transition towards purely ontological conceptions of disease was complex.

There were many different versions of disease causation related to zymotic theory, but they were not primarily about "filth"; ideas about disease causation and transmission were more medically and scientifically sound. Moreover, there was a shift in the way these diseases were understood based on the massive amount of evidence compiled during the war, which would ultimately support ontological conceptions of disease. First, the importance of asepsis in the hospital setting and in treating these diseases was consistently reinforced, and secondly, the use of chemicals or antiseptics to prevent "putrefaction" or destroy "poisons" was considered crucial in the treatments employed. Finally, there was strong evidence in favor of some sort of contagion as being involved in the transmission of these diseases, which would later support emerging work in bacteriology. The *Medical and Surgical History* noted of gangrene that "no certain cause for the disease except contagion has been determined" though there was still a belief that "a depression of the vital forces has been favorable to its accession."[279]

Some physicians requested microscopes to detect specific "vibrios," "cells," "fungi" or "animalcules." This led to new worlds related to disease, but more importantly, diseases were studied in a location away from the patient, changing basic assumptions about how to investigate disease processes. Others found their niche in testing and experimenting with therapeutics, and the work of still others laid a foundation for developments in public health. Perhaps most importantly, the government recognized the value of medical research in these investigations and offered both financial and technical support for this research. Considering the fact that Joseph Woodward had never seen a case of gangrene just two years earlier suggests that American physicians came along way in a very short time. Moreover, the idea of specializing and becoming an "expert" in these investigations was an attractive prospect for many of these physicians. New intellectual frontiers were encountered and identities were formed in these investigations. As Goldsmith remarked to Hammond, "I have to thank-you for the abundant opportunities which you have given me for pursuing my investigation into bromine as a treatment to their present fruition."[280]He also remarked to Brinton of his

[279] *Medical and Surgical History* Vol. II, Pt. III, p. 849.
[280] RG 94 (NARA) Medical Records, 1814-1919 D File, Box 15 Entry 193. Letter from Goldsmith to Hammond, August 26, 1863.

observations into erysipelas and pyemia that the work was "striking and important."[281] Goldsmith was not alone in being able to position himself as "expert" on a specific class of disease or area of medicine during the war; with the opportunity to pursue specialized areas of study, physicians could achieve a new type of professional dominance.

[281] Ibid. Letter from Goldsmith to Brinton, March 22, 1863.

Chapter Three:
Research, Bodies and the Development of Medical Specialization:

The Civil War provided unparalleled opportunities for a physician to develop an expertise in a specialized area of medicine by the institutionalization of medicine within the context of the military, the unprecedented opportunities for hospital work, the number of patients and cases that continually had to be monitored and most importantly, the demand for specialized expertise. Physicians were often challenged by the patients under their care, particularly since the range of unfamiliar diseases and cases manifested peculiar and often devastating symptoms. Medical specialization, once associated with anti-intellectualism and quackery,[1] now had a new intellectual dimension: becoming an expert could save lives, conferring a measure of status and identity on the physician who could successfully diagnose, manage and treat these challenging cases. Indeed, Silas Weir Mitchell hoped that his work and research at Turner's Lane Hospital would "become a means of aiding a neglected class of sufferers."[2] Prior to the war, physicians may have come across a specific type of case or class of disease only infrequently, thus trying to forge a career in treating just the eye or ear or heart disease for example, would have been very difficult and not financially viable. This changed during the war, and specialized hospitals were introduced for practical purposes: the classification of specific diseases could streamline medical practice during the war.[3] Those physicians interested or adept at managing a particular class of disease often earned the appointment of surgeon in charge, or a post at a specialty hospital enabling him to develop his interest and expertise. This was significant: the separation of specialties facilitated their development by allowing doctors to focus on a *specific* area of medicine. While those who had benefited from foreign travel, particularly to Paris and Vienna, had seen the efficacy of specialization, it was not until the emergence of a new intellectual environment that specialization in

[1] In the early 19th century specialism was a hallmark of the charlatan. Regular physicians were required to have a well-rounded view of all aspects of medicine (therapeutics, diagnosis, the body—all parts of the human body not just the eye or ear for example). Stevens argues that in the early 19th century the "self styled specialist (bonesetter, pile doctor, or clap doctor was often little different from a quack; and the energies of the medical profession had long been devoted to stamping out such phenomena," because their actions undermined the general practitioner. Stevens, P. 44. Physicians could be interested in specific facets of medicine, but needed to have a well-rounded view of medicine and disease and not specifically declare themself a specialist.

[2] Silas Weir Mitchell, George Morehouse and W.W. Keen, *Gunshot Wounds and Other Injuries of Nerves*(Philadelphia: J.B. Lippincott and Co., 1864) p. 143.

[3] Including diagnosis, treatment and patient management.

medicine could develop in America. This was largely due to the institutional culture of the military, support for research and the volume of unprecedented medical experience that defined wartime medicine.

At the request of the Surgeon General, thousands of physicians contributed to the medical museum, published their case histories and contributed essays about disease and hospital management. The result was a more unified body of medical knowledge. Physicians became part of a shared medical experience allowing medicine overall to become more united (in practice, knowledge production, diagnoses and other aspects); and as epistemological authority developed during the war specialties in medicine became more plausible, perhaps inevitable. Perhaps most important was the new focus and reverence for medical science, of which specialization was a natural extension.[4] Specialties in medicine, as defined by William Rothstein, are the imperative among physicians to "take a special interest in a particular class of disease" or the "authority based on special knowledge."[5]However, specialties were not fully formed professional categories before, during or even immediately after the war.[6] It is important then to think of specialized study during the conflict as the attempt of some physicians to respond to the challenges that demanded specialized expertise and intervention while also profiting professionally from the opportunities that were presented. Circulars No. 2 and 5 converged in an interesting way to support the development of this specialization. In addition to emphasizing the new pathological conception of disease, institutional support in the form of specialty hospitals and the use of new technologies, the circulars helped to create a new intellectual space in the circumstances of war. By requesting physicians to research and produce knowledge related to various diseases and specific methodologies, the circulars supported the development of the "expert."Two things happened. First, as

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[4] I would suggest here also that wartime research allowed physicians the opportunity to forge an intellectual connection with each other rooted in common interests but also an intellectual distance from the patient and larger public who no longer understood the intricacies of medicine.

[5] William Rothstein, *American Physicians in the Nineteenth Century: From Sects to Science* (Baltimore: The Johns Hopkins University Press, 1985) p. 7.

[6] American Ophthalmological Society, 1864; American Otological Society, 1868; American Neurological Association, 1875; American Dermatological Association, 1876; American Gynecological Association, 1876; American Laryngological Association, 1879; American Surgical Association, 1880; American Association of Genito-Urinary Surgeons, 1886; American Orthopedic Association, 1887; American Pediatric Society, 1888; American Laryngological, Rhinological and Otological Society, 1895; American Academy of Ophthalmology and Otolaryngology, 1896; American Gastroenterological Association, 1897; American Proctological Society, 1899; American Urological Association, 1902. See Rothstein, p. 213; Stevens, p. 46.

some physicians wrote their case reports as required by Circulars No. 2 and 5, there were some diseases far beyond their medical knowledge, which numerous letters to the staff at the Army Medical Museum asking for advice about diagnosing specimens or unfamiliar diseases reveal. In turn, Woodward and Brinton replied correcting misdiagnoses or consulting with a specialist in the study of that particular disease during the war. This created a hierarchy of knowledge; as some felt their limitations, others carved out fields of investigation, interpretation and intervention in the management of particular diseases. The official designation of specialty hospitals and wards for the research and management of specific diseases was significant. The Army Medical Museum, a national pathological cabinet, as an institutional base to accommodate and foster these developments, ensured that specialized study became a visible and thus less contested form of medical practice.[7]

In considering the evolution of specialization in medicine there are certain benchmarks generally associated with its emergence that did not develop during the war—including standardized training programs, regulation boards, university based teaching, formal associations, and the line between observation and experimentation. But some benchmarks did develop during the war, including the most important impetus to clinical specialism in the second half of the nineteenth-century: an intellectual foundation. Some physicians had yearned to develop the medical sciences prior to the war and were frustrated by the lack of support for scientific medicine in America as compared to Europe. As Silas Weir Mitchell observed two years prior to the war:

> ....Considering the adventurous ingenuity of the national mind, as well as the solid character of its achievements in other lines of scientific research, it is not easy to see why a science so eminently experimental as physiology, should be able to boast so few active laborers and so small a number of conspicuous results. Still, even the last year shows a remarkable improvement and we may hope, at least, that he who ten years hence

[7] By the third quarter of the 19th century the general practitioner feared the well-trained, scientific specialist because the rank and file had trouble competing. They may not have had the opportunity to study in the speciality clinics in Europe, or have had the financial resources to focus only on one area of the body. Rothstein demonstrates that many GPs were "skeptical of the value of specialization"....."because many specialists were self-designated and had little or no special training." See, William Rothstein, *American Medical Schools and the Practice of Medicine* (New York: Oxford) p. 72. Thus the war was a crucial educational intervention for the new American specialists as it provided an important period of training in which to master specific diseases and medical challenges—but also to assert themselves as expert.

reviews the earning of our physiological workers may have a larger sum of original results to cast into the lap of the great Mother Truth.[8]

There was a great impetus towards scientific medicine in the second half of the nineteenth century and for some physicians it was the wartime medical culture that produced the innovations in diagnoses, treatment, experimental medicine and informal associations. Indeed, the specialty divisions within the Civil War hospitals and high status for the physicians in charge of them, government sponsored research projects, resources for specialized study and the sheer growth of the medical profession all supported the development of medical specialization. This intellectual foundation also extended to the public. With sons being treated in Turner's Lane Hospital for neurological disorders by Silas Weir Mitchell or for heart conditions in Jacob DaCosta's ward, the public gradually accepted medical specialization as a new social category. The examination of medical specialization during the war illustrates well the cross influences of American civil and military medicine and the important role that the wartime research and investigative medicine had in the larger development of American medical science.

Rather than focusing primarily on the professional structures underlying specialization, this chapter examines its intellectual origins, the collegial and institutional support for specialization in the context of wartime scientific medicine, which made medical specialization attractive and perhaps inevitable. In tracing these intellectual origins this chapter will look at many specialties in order to gauge both the impact of scientific medicine[9]and how it was used to advance specific areas of medicine. It will demonstrate that as medical science developed and became more accepted among physicians, support for medical specialization increased among medical professionals. A number of specialties emerged during the war and this chapter will emphasize that they developed from the same impetus or needs, and that the various specialisms can be traced to the same trends in medical practice during the war. The war produced conditions in which unfamiliar health problems and unprecedented medical challenges developed creating a new demand for specialized expertise.

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[8] Silas Weir Mitchell,"Report on the Progress of Physiology and Anatomy," *N.Am. Med. Chir.* Rev 2 (1858):105-119. Quoted in W. Bruce Fye, *The Development of American Physiology: Scientific Medicine in the Nineteenth Century* (Baltimore: Johns Hopkins University Press, 1987): p. 59.

[9] In particular the effect of Circular No. 2 and Circular No. 5: the development of localized pathology, clinical research, transmission and networks of knowledge and the institutional support conferred by the AMM.

Access to bodies also supported the development of investigative medicine in the laboratory, including histological research and photomicrography, which was increasingly utilized and developed to better understand and illustrate disease processes. Perhaps owing to the unusual nature of the wounds and diseases encountered, those doctors who were charged with the study of specialized diseases enthusiastically embraced experimental medicine and research which supported the development of new, scientifically sound methodologies, adopted by the next generation of specialists. The development of the various specialisms was uneven.[10] Neurology, for example, established a foundation to investigate and diagnose neurological disorders and a significant record of this work was published and later consulted by medical professionals around the world. Developments in "plastic operations" on the other hand were less common and left a smaller body of work but still supported the idea of specialized study. Other areas including cardiology, ophthalmology, dentistry, public health, photomicrography, dermatology and some surgeries illustrate the dynamism of the war in relation to the development of specialization. Physicians left an interesting body of published work, which was later referred to by medical schools, medical students and medical professionals in the post-war period, in many ways legitimizing the efficacy of medical specialization as a new professional category.[11]

Organization of Wartime Medicine:

At the outset of the Civil War, Union medical professionals were forced to seize churches, factories, barns and even large private homes for the wounded because there were very few permanent hospitals and certainly not enough to care for the mass casualties. Deserted barracks were used at first to treat the wounded and eventually immense pavilion hospitals were constructed. Silas Weir Mitchell recalled, these hospitals each held from "one thousand to six thousand patients and they sheltered thirty-thousand beds in and around Washington, and that near to Philadelphia we had twenty-six thousand, about twenty-thousand of these being in neatly constructed pavilion ward

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[10] Precedence in this chapter will be given to the specialties that left a more substantial body of work (neurology, heart disease, pathological specialism and plastic operations), but other specialties will be briefly discussed as examples of the development of the medical sciences.

[11] Both during the war, and as a mode of practice.

hospitals."[12] He recognized the value of so many patients and suggested that "the American physicians, quick to learn, profited by their vast clinical opportunities."[13] The hospitals gave physicians valuable clinical experience but it was also a place in which professional aspirations developed. This overlap proved an important stimulus for the development of clinical specialism by showing medical professionals the efficacy of linking hospital work with medical education.[14] Like Mitchell, many of the doctors that supported this model had had the benefit of a hospital position or training in Europe prior to the war and the war provided an opportunity to redirect the focus of American medicine along the same lines. Physicians had long seen the need to expand medical knowledge in America and the war provided the fresh intellectual environment in which scientific and educational opportunities could be pursued within the military organization:

> I have the honor herewith to forward for your approval my special requisition for the books which are italicized on the supply table. I am confident that the works asked for could and would, be used by the medical men here to the great advantage of the service. That they are needed is evident from the facts that they have never been supplied; that this is a permanent post of a central character; and that a large number of cases for the action of examining boards are continually accumulating here. The works more particularly desired are those treating the specialty of the eye, ear, skin and venereal.[15]

Physicians designated "specialists" were revered for their expertise in a way they had not been prior to the war.[16] Indeed, the competition among general practitioners and specialists before, and to a lesser extent after the war, was not so profound during it, largely because specialists helped to manage the diseases and disorders with which many doctors had little familiarity or desire to treat. In an already overwhelming medical situation, specialty hospitals and doctors were instrumental in helping to manage the medical challenges. As Mills Madison, Medical Directors Office, St. Louis noted:

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[12] Silas Weir Mitchell Papers, Library of the College of Physicians, Philadelphia, Box. 17 Series 7. MSS 2/0241-03 p. 20. "Address before the Physicians Club Chicago, Ills. 1902/March/25."
[13] Ibid.
[14] Many of the physicians that had studied in Paris sought to replicate this model in America. Physicians studied and learned from their hospital patients; the familiar and unfamiliar diseases. They created an environment in which to learn so the thousands more that came through the wards could benefit from efficacious treatments or preventive medicine.
[15] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870, Entry 12, Box 66. Letter to Hammond from Thomas McFadden, Post Hospital Camp Chase, Ohio, August 23, 1863.
[16] There is an important economic factor here: physicians were being paid by the state to treat national troops who needed general care, but also in some cases, specialized care.

I have the honor to request that a surgeon who has experience in the treatment of diseases of the eye be sent out here for the purpose of taking charge of a large and increasing number of cases occurring in the hospitals of this department.[17]

Along with the destructiveness of the minie ball, which demanded new approaches to medical treatment, it was Circulars No. 2 and 5 requiring the study of patients and specimens along with mandatory case reporting which encouraged consultation about difficult and unfamiliar cases and laid an important foundation for medical specialization. As Mitchell recalled, "Thousands of pages of notes were taken. There were many operations, many consultations, and toward the close we planned the ultimate essays which were to record our work."[18]Circular No. 5, which mandated the transmission of this knowledge, helped to advance new scientific ideas, techniques, therapeutics and theories creating a vibrant interest in specific facets of medicine rather than the generalized approach to the body that had dominated prior to the war. As shown in the previous chapters, some hospitals became sites in which pathological, chemical and microscopial investigations were employed, encouraging an epistemological shift among some physicians and conferring epistemological authority upon others. In order to effectively understand, treat and diagnose patients, physicians had to conduct specific investigations to manage the unfamiliar manifestations of disease that they encountered during the war, which changed the way many thought about disease and practiced medicine.

Robert Bruce has suggested that the Civil War retarded scientific development in the United States by diverting resources away from developing laboratories and scientific pursuits.[19] However, he neglects to recognize the importance of this "diversion" for the medical sciences (which he does not consider).[20]As Medical Inspector of the Hospitals, John L. LeConte received a copy of Circular No. 2 and was ordered to "collect for the museum as much as possible. The first catalogue will be published January 1st, and I am anxious to get all I can. If you will get together all your specimens, no matter how rough

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[17] RG 112 (NARA) Central Office Correspondence, Entry 7, Box 66. Letter from Mills Madison, Medical Directors Office, St. Louis, MO. Jan. 22, 1864.

[18] Silas Weir Mitchell Papers, Library of the College of Physicians, Philadelphia, Box. 17 Series 7. MSS 2/0241-03 p. 20. "The Medical Department in the Civil War: Address before the Physicians Club Chicago, Ills. 1902/March/25." P. 36.

[19] See Robert V. Bruce, *The Launching of American Science, 1846-1876* (Cornell University Press, Ithaca, 1987) pp. 276-81.

[20] Ibid. p. 6.

and put them in the brandy keg with a little whiskey and forward them to me with a history of the cases I should be much obliged. We want for the museum everything."[21] One result of this order was that it led to a shift (at least for the time being) for some men in terms of their scientific pursuits. John LeConte, a well-known naturalist and entomologist and a prominent member of the international scientific community in the development of these sciences,[22]through the war was able to develop his interest in the medical sciences while helping to transform American medicine. Though LeConte initially viewed the war as a distraction to his work and an annoying political controversy, he rallied to the cause of the Union and proved extremely valuable in his capacity as medical inspector, and ultimately to medicine. He was first elected an associate for Philadelphia of the U.S. Sanitary Commission, but later secured a rank of Lieutenant Colonel and the position of Medical Inspector of the United States Hospitals in Philadelphia.[23]He was particularly effective in improving hospital record keeping. As he noted to Brinton, "my object was to produce a series of hospital records from which the nature of treatment of the cases could be learned and from which a student desiring a monograph on a particular subject could procure satisfactory information to dispense thereby with the prescription and diet books as at kept."[24]LeConte similarly proved instrumental with his recommendation and support for the development of specialty hospitals in Philadelphia. Through his collection and management of bodies and specimens he saw the variety of diseases and the efficacy of specialists for the management of them. He proposed specialized hospitals "for certain classes of cases" and where possible "placed under the right kind of man."[25]He noted, "in the case of gunshot fractures it appears to me that the medical director can easily ensure better success by sending all such cases to a particular hospital to be healed by some particular surgeon."[26] There was even debate about the efficacy of having all specialties in one specialty hospital or rather separate hospitals (ultimately some were housed in the same hospital in

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[21] John LeConte Papers (APS) B L 493. John Brinton to Joseph LeConte, Oct. 29, 1862.
[22] LeConte published more than 200 papers on coleoplera and described about 270 species of scarabaeoidea, which were re-published in Europe. He studied medicine at the College of Physicians and Surgeons in New York but did not practice medicine until the Civil War. John LeConte Papers (APS) B L 493.
[23] John LeConte Papers (APS) B L 493.
[24] RG 94 (NARA) Medical Records, 1814-1919 D File, Box One, Entry 623: "Letters and Memorandums from John Brinton: Letter to Brinton from John LeConte, Nov. 17th, 1863.
[25]John LeConte Papers (APS) B L 493. Letter from John M. Cuyler to John LeConte, Dec. 9, 1863.
[26] Ibid.

separate wards, while others had a separate hospital designated).[27]LeConte was instrumental in contributing to the dialogue about specialism in medicine, and on a more practical level how best to manage different diseases and disorders.

At first the development of specialty hospitals was a very challenging undertaking. As Silas Weir Mitchell observed in 1864:

> Many difficulties and embarrassments naturally arose at the outset of an undertaking so novel as that of a special hospital meant to receive only a limited class of cases. As the Surgeon General increased the number of such hospitals, creating distinct wards for various classes of diseases, these obstacles soon disappeared, and the good results of the system became apparent.[28]

It soon became necessary to employ an executive officer in the general hospitals whose duty it was to "assign new patients to the wards" and also "transfer the cases in the specialties such as the eye, nervous diseases, and injuries etc. to the special hospitals."[29] By 1863 special wards "had been appropriated by order of Hammond in several hospitals for the treatment of special diseases," including heart diseases, nervous diseases, injuries of the eye and ear and skin ailments.[30]These special wards proved useful for managing patients but also for small groups of physicians and researchers. The knowledge that specialized cases provided, the institutional support for hospitals and bureaucrats, and the desire of the physicians such as Mitchell, DaCosta and Keen, proved very important for the development of medical specialization.[31]It was scientific and reform-minded men like Hammond who could lead the charge, but men like LeConte, not previously associated with the organization of medicine in a significant way also aided in the development, demonstrating the importance of the war years in the reform of American medicine.[32]

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[27] Ibid. Letter from John M. Cuyler to John LeConte, Jan 3, 1864.

[28] Silas Weir Mitchell, George Morehouse and W.W. Keen, *Gunshot Wounds and Other Injuries of Nerves.* (Philadelphia: J.B. Lippincott and Co., 1864) p. iii.

[29] William Williams Keen, "Surgical Reminiscences of the Civil War" in *Addresses and Other Papers* (W.B. Saunders & Company, 1905) p. 437.

[30] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870, Entry 12: Box 21. From the Department of Lusquemhama Medical Director's Office, John Campbell to the Surgeon General's Office Oct. 6, 1863.

[31] George Rosen has similarly shown that the creation of "specialized hospitals provided centers for the transmission and development of knowledge and skills connected with the special field of practice." See. *The Specialization of Medicine*, p. 39. Charles Rosenberg has also illustrated the importance of specialized departments in the general dispensaries to accommodate professional goals and in the development of medical careers. See, "Social Class and Medical Care in Nineteenth-Century America: The Rise and Fall of the Dispensary," *Journal of the History of Medicine and Allied Sciences* (29), 1 1974: 223-253.

[32] John L. LeConte also formed life-long associations through his work in the war. He conducted a number of experiments at the request of Joseph Henry with Joseph Woodward on all forms of specimens. They studied, microscopically, certain fabrics, foodstuffs, calf hair goods, anthropological specimens and bodies. See, John LeConte Papers (APS) B L 493, 1875-1876, series of letters between Woodward, LeConte and Joseph Henry (all of the work

Nostalgia, Neurosis and Nerve Disorders: Turners Lane Hospital and the Development of Neurology:

The practices and principles established during the war among some physicians would have a profound influence on the way in which specialization was organized and shaped in American medicine. W. Bruce Fye has suggested that Silas Weir Mitchell was part of a small group of American physicians who wanted to make "greater efforts to expand man's knowledge of his body, his environment, and the universe" and was thus part of a "network of American scientists who wanted to introduce the research ethic into American higher education."[33]But in the mid-nineteenth century there were both limited opportunities and a lack of structure in America in which specialized research could be pursued. This void was, in part, filled by the creation of the Army Medical Museum and the increasing support for specialized centers of study, including specialty hospital wards. As Fye suggests, "the morbidity and mortality of the Civil War set the stage for an abrupt shift in Mitchell's career."[34]It was during this important period in Mitchell's career that he was able to make perhaps his most significant contribution to medicine: the development of neurological research and treatment in America. Fye, however, suggests that the focus on clinical research during the war limited the time designated for laboratory work and thus Mitchell's "scientific productivity declined."[35] This assertion stems in part because of Mitchell's own desire to obtain a physiological chair, and his failure (and the concomitant institutional support for scientific research) has often overshadowed his contribution to clinical specialization.[36]But Mitchell's wartime investigations (which were almost completely clinically oriented) established the way in which neurology was practiced in America. This was a remarkable turning point in Mitchell's career, particularly when considering his past endeavors:

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was ordered by the Smithsonian and undertaken at the Army Medical Museum). The reports were later published in various medical and other journals including the *Boston Wool Manufacturers Association Quarterly*, which illustrates the diversity of interest.

[33] Fye, p. 60.

[34] Fye, p.63.

[35] Assuming laboratory specialism was more scientific than clinical specialism; and the development of physiology over the founding of neurology, a new specialism, took precedence. In antebellum America, no such opportunity existed to create a foundation for neurological study and Mitchell was keenly aware of both the opportunity he had and the contribution he could make to science. I would say he was torn, between his prior interests in physiological research and his opportunities during the war. Fye does however suggest that Mitchell's wartime work was important, but secondary to his interest in physiology. p. 68.

[36] Bruce Fye. S. Weir Mitchell, Philadelphia's Lost Physiologist."*Bulletin of the History of Medicine* 57(1983):188-202

Preceding the turning point in Mitchell's career, in 1863, when he assumed medical charge of an army hospital for nervous diseases, he had published not less than twenty-two medical papers and reports, none of them clinical and nearly all in the domains of physiology, pharmacology, and toxicology.[37]

In his new specialty he became a mentor for George Morehouse and W.W. Keen who recalled that working with him was "the most fortunate event of my professional life that I came under his stimulating and elevating influence" and that *Gunshot Wounds and Other Injuries of the Nerves* based on their wartime research, was an important publication "setting forth a novel theory of shock."[38]The war work helped usher in important institutional forms of modern science including research programs and publications. As Keen observed:

The good fortune I had of falling at once under the stimulating influence of Weir Mitchell at the very beginning of my medical studies is largely accountable for my later career. I was stimulated at once into authorship. My first work was in reports of cases during the Civil War many of them will be found in the Medical and Surgical History of the War of the Rebellion.[39]

The publication was based on the research and cases from Turner's Lane Hospital in Philadelphia, which opened in August 1862 for the treatment of nervous disorders and wounds of the nerves. Mitchell was also assigned as contract surgeon to Filbert Street Hospital (where he became interested in nerve wounds) and Christian Street Hospital, opened June 1861 (first organized for the treatment of nervous diseases). It was during his tenure there that he began to develop his expertise in the nervous diseases that he observed in the soldiers.[40]According to Mitchell this "so pleased the Surgeon General that a hospital for neural disorders was created at Turner's Lane in August 1862, and pavilions were built for four hundred men."[41] It is significant that Turner's Lane was built specifically to treat neurological disorders, providing an institutional base for both clinical research and scientific advances.

The Army Medical Museum also provided institutional support for the development of medical specialisms. For example, Thomas Carroll of Co. D, 3d New

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[37] William H. Welch, "S. Weir Mitchell: Physician and Man of Science" in *S. Weir Mitchell, M.D., L.L.D, F.R.S 1829-1914 Memorial Addresses and Resolutions* (Philadelphia, 1914) p. 109.
[38] Keen, *Reminiscences* (APS) BK 245 p. 32.
[39] Ibid. p.98
[40] Silas Weir Mitchell Papers, Library of the College of Physicians, Philadelphia Box. 17 Series 7. MSS 2/0241-03 p. 20. "The Medical Department in the Civil War: Address before the Physicians Club Chicago, Ills. 1902/March/25."
[41] Ibid.

Jersey, had been injured by a pistol ball while seated on a fence rail, suffering paralysis and atrophy of the arm muscles, likely owing to a lesion of the spinal centres. One of the interesting characteristics of the case was that his left shoulder muscles were "fearfully atrophied," prompting Mitchell to make casts of both shoulders, which were sent to the museum to illustrate the "deformities" caused by the disorder (classed as a wound of the nerve centre).[42]Doctors both civil and military eagerly visited the museum, which showcased the physical manifestations of relatively unfamiliar disorders. Brinton recalled of the museum:

> Its claims to usefulness are recognized by the civil profession throughout the country and it is used by them weekly and almost daily considered. The cabinet as it stands is not a mere museum of curiosities. It is a collection which teaches. It is practical and has already powerfully influenced for the better the treatment of the wounded soldier. In confirmation of this assertion I would simply recall to your mind the lessons to be deduced from the study of the specimens on the shelves, of injuries of the joints from conoidal balls; a class of injuries previously almost unknown and the treatment of which at the commencement of the war was unsettled.[43]

This national recognition of neurological disorders supported the development of medical specialization by recognizing the need to study *specific* facets of medicine in contrast to the more traditional method of approaching disease as a general disorder of whole body.[44] It was important that the Surgeon General's office encouraged and fostered this development:

> The attention of medical officers in charge of USA General Hospitals is invited to the importance of preparing illustrations of the results of surgical operations. These can in many instances be conveniently obtained by means of plaster casts, which are readily made without subjecting patients to the slightest inconvenience. In selecting the proper subjects for representation, it would be well to choose not only cases in which results have been favorable, but also those in which they may have been unfavorable. In a collection like the National Museum truthful representations of both good and bad results are alike instructive and valuable for future reference and study. All preparations should be accompanied by proper histories, with name, rank, and station of contributor, who will be duly credited in the museum catalogue.[45]

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[42] Silas Weir Mitchell, George Morehouse and W.W. Keen, *Gunshot Wounds and Other Injuries of Nerves.* (Philadelphia: J.B. Lippincott and Co., 1864) pp. 32-33.
[43]RG 94 (NARA) Reports of Diseases and Individual Cases File A. Report prepared by John Brinton to Joseph Barnes, 1864.
[44] In fact the very nature of the AMM, which displayed diseased body parts, encouraged a narrower focus on the body, which illustrated the need to pursue a more specialized study of the body.
[45] RG 112 (NARA) Central Office Issuances and Forms: Circulars and Circular Letters of the Surgeon General's Office, 1861-85 Entry 63(7 volumes) Circular No. 26 Issued by Barnes Nov. 24th, 1863, p. 296.

The organization of a specialty hospital devoted to neurological disorders also allowed for the recognition of a previously underdeveloped category of disease and encouraged research and publications. The government supported the new specialty hospitals financially and intellectually by recognizing these specific disorders, but with the expectation of doctors publishing their findings for the benefit of military medicine.

Surgeon Alden of the regulars was in charge of Turner's Lane (primarily handling administrative matters); the remaining staff consisted of George Morehouse, Keen, Mitchell and Jacob DaCosta who was assigned his own ward for the study of "exhausted hearts." Mitchell and Morehouse divided their time between their general practices and Turner's Lane Hospital.[46] Their day usually consisted of a visit to the hospital by 7:00 am, a stop in at their own practices, followed by a late afternoon and evening visit to Turner's Lane.[47]Prior to being assigned at Turner's Lane, Morehouse worked as an assistant surgeon at the general hospital at 16th and Filbert Street and performed a number of surgeries including trephining to treat an abscess of the brain following a gunshot wound.[48] Morehouse was extremely interested in injuries of the brain, and thrilled to receive an appointment at Turner's Lane. Keen had worked at various hospitals during his first 16 months of service and was also the Army Medical Museum's representative in Frederick and Philadelphia, where he gathered and forwarded specimens to the museum. He was ordered to the Christian Street Hospital and then Turner's Lane where he pursued his interest in diseases and injuries of the nervous system.[49]It was a period in their careers that they clearly relished: "Several nights each week we worked at note taking often as late as twelve or one o'clock in the morning and when we got through we walked home a couple of miles talking over our cases."[50]Mitchell demanded meticulous research and case reporting as Keen recalled: "He taught the important art of elucidating the case

[46] It is interesting to note the interconnectedness of civil and military practice during the war. Historians often treat each area as a separate influence on 19th century medicine, but many physicians seized the opportunity of the war, particularly for a hospital post, while maintaining civil practices and teaching appointments in the medical schools.
[47] Silas Weir Mitchell Papers, Library of the College of Physicians, Philadelphia Box. 17 Series 7. MSS 2/0241-03 p. 20. "The Medical Department during the Civil War: Address before the Physicians Club Chicago, Ills. 1902/March/25."p. 36.
[48] RG 94 (NARA) Reports of Diseases and Individual Cases File A "Special Cases in USA General Hospital 16th and Filbert Street, Reported by George Morehouse, Oct. 31, 1862.
[49] W.W. Keen, "Surgical Reminiscences of the Civil War" in *Addresses and Other Papers* (Philadelphia, W.B. Saunders and Company, 1905) pp. 435-436.
[50] Silas Weir Mitchell Papers, Library of the College of Physicians, Philadelphia, Box. 17 Series 7. MSS 2/0241-03 p. 20. "The Medical Department during the Civil War: Address before the Physicians Club Chicago, Ills. 1902/March/25." p. 36.

histories of patients; the importance of little hints which were often the insignificant surface out-croppings of a rich vein of facts; the importance and methods of cross-examination to ferret out the truth, and above all the ability to interpret these assembled facts in making a diagnosis."[51]The work was more than any of the physicians involved in the project had ever been engaged:

> We three did all the work in person. There were no stenographers or any such help, and sometimes the inflow of cases of injuries after a serious battle tasked us sorely. I have worked with many men since, but never with any who took more delight in repaying the opportunity by labor. The opportunity was unique and we knew it. The cases were of amazing interest.[52]

The cases which they diagnosed were varied and novel for Mitchell, Morehouse and Keen, consisting of a range of neurological disorders including epilepsy, nerve wounds, palsies, reflex paralysis, singular choreas and stump disorders. The cases proved a constant source of interest and learning, "if urgent calls took us into town, we returned to the hospital as if drawn by a magnet. In fact it was exciting in its constancy of novel interest."[53]The eminent physician William Welch later recalled of the work at Turner's Lane:

> One is reminded of the almost feverish activities of the young Bichat in the Hotel Dieu by the work, until the late hours of the night, of these three ardent investigators, minutely observing and recording in thousands of pages of notes phenomena often both new and interesting, analyzing, conferring, apportioning to each his share in working up the results. The opportunity was unique and they seized it with full realization and utilization of its possibilities.[54]

The development of neurology during the war was less about organic localism or the unification of medicine and surgery[55]than an opportunity for clinical research of the many nervous cases that resulted, the institutional support provided by the Union medical department and the recognition of this unique challenge. As Mitchell, Keen and Morehouse recalled of the number of cases presented for treatment:

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[51] W.W. Keen, Tribute to S.Weir Mitchell in *S.Weir Mitchell, Memorial Addresses and Resolutions* (Philadelphia, 1914) p. 16.
[52] Ibid.
[53] Ibid.
[54] William H. Welch, "S. Weir Mitchell: Physician and Man of Science" in *S. Weir Mitchell, M.D., L.L.D, F.R.S 1829-1914 Memorial Addresses and Resolutions* (Philadelphia, 1914) p. 117.
[55] With the exception of orthopedics, an area Mitchell and Keen did work in at Turner's Lane, but which will be given separate treatment in this paper.

> Among them were representatives of every conceivable form of nerve injury—from shot and shell, from sabre cuts, contusions and dislocations. So complete was the field of study that it was not uncommon to find at one time in the wards four of five cases of gunshot injuries of any single large nerve. It thus happened that phenomena, which one day seemed rare and curious, were seen anew in other cases the next day, and grew commonplace as our patients became numerous.[56]

Prior to the war, Mitchell had been almost singularly focused on physiological research which he incorporated into his work on neurology.[57]In the 1850s, having recently been exposed to the work of Claude Bernard and Charles Edouard Brown-Sequard, he began a series of varied physiological investigations, employing chemical and microscopial methods in his work. He examined uric acid crystals and their alterations in highly acid urine,[58]looked at relations of the pulse to fixed statistics of deep inspiration or expiration,[59] blood crystals of the sturgeon[60] and the muscular phenomena following a blow on the muscle from a percussion hammer (a lab experiment on the contraction and secondary, local or hump reaction).[61]With Hammond, he undertook experimental studies of poisons from the Rio Darien and demonstrated they were powerful cardiac poisons.[62]The two studied the toxilogical effects of sassy bark, the alkaloids of corroval and vao,[63]the venom of the rattlesnake, and an investigation of the anatomy and physiology of the respiratory and circulatory organs, the toxicology of arrow, ordeal poisons and snake venom, later described as "a perfect model of what investigation into the physiological action of a poison ought to be."[64]They also examined the circulation, physiology and respiration of the chelonian, and the treatment of rattlesnake bites.[65]While Mitchell acknowledged that "the years from 1862-1865 left a busy Army Surgeon small leisure for lab work," he also recognized that "the organization of the Christian Street Hospital for nervous diseases and later that of Turner's Lane

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[56] Mitchell, Keen and Morehouse, *Gunshot Wounds and Other Injuries of Nerves*, Philadelphia, 1864 p. 9
[57] For example in reference to the knee jerk, the contraction of certain muscles was seen by Mitchell as a physiological contraction in response to a blow upon the body (tendon tap results in the reply of a jerky kick). See, Silas Weir Mitchell Papers, 1850-1928 MSS 2/0241-03. Library of the College of Physicians, Philadelphia.
[58] *American Journal of the Medical Sciences* Vol. xxiv p 121, p.4.
[59] *American Journal of the Medical Sciences*, Vol. xxvii p. 367 p. 12.
[60] *Academy of Natural Sciences* Vol. X, 1858 p. 2.
[61] Ibid.
[62] *Academy of Natural Sciences*, Vol. xxxviii p. 13.
[63] Ibid. April, 1860 p. 4, p. 10.
[64] Silas Weir Mitchell Papers, 1850-1926 MSS 2/0241-03 Reprinted From *Nature*, January 1, 1914.
[65] The Smithsonian Contribution to Knowledge, 1860 p. 150. For a complete list of his publications see Silas Weir Mitchell Papers, 1850-1928 MSS 2/0241-03, Series 7.5 "Analytical Catalogue of Work."

afforded a chance for study unknown before."[66]His wartime experiments and publications reflect his new opportunities, but his approach to neurology was clearly influenced by his training and expertise as a physiologist.[67]Bonnie Ellen Blustein demonstrates that "conventional lesion-oriented pathology coexisted in Hammond's work with a new and rather vague functionalism rooted in his physiological experience......the neurologist could consistently hold out hope for recovery only if the disorder were functional rather than the result of organic damage."[68]The coexistence of localized pathology and functionalism was similarly adopted in Mitchell's neurological work. It was more common to treat the disorders as functional rather than organic because the nerve wounds were generally the result of a gunshot wound and during an autopsy organic lesions were commented on less.[69]Mitchell did examine various organic symptoms related to brain and spinal injuries such as congestion, meningitis, hydrocephalus, hemorrhage, tumors, softening, atrophy, myelitis, hyperaemia but more cases exhibited functional disturbances such as headache, trance, hysteria, delirium, chorea, reflex spasms, tetanus etc. If a minie ball, for example, damaged any large nerve there was a corresponding destruction of function as the bullet could sever the nerve fibres.[70]It was common when a nerve was damaged to examine a number of changes in the muscles including paralysis as to will, loss of tone and firmness, loss of electro-muscular contractility, loss of electro-muscular sensibility; atrophy and contraction. Mitchell looked also at what he referred to as "diseased muscles," the ability or inability for volitional movement and the effects of electricity on the muscle.[71]He studied the influence of nerve lesions on nutrition, on local temperatures, on the various senses, and fatigue and exhaustion on nerve cells due to peripheral irritation of the nerve. His greatest contributions to the field are generally

[66] Silas Weir Mitchell Papers, 1850-1928 MSS 2/0241-03, Series 7.5.

[67] It is also important to note that prior to the war Mitchell and other elite physicians pursued scientific experimentation almost as a hobby; during the war, the experiments and work had immediate and significant clinical relevance, which Mitchell commented on frequently.

[68] Blustein, *Preserve Your Love of Science*, p. 127.

[69] For example shock may have manifested specific functional disorders (headache, confusion, spasms, and dizziness) similar symptoms to a brain tumor, but there would be no organic symptom (ie. tumor). This distinction was important, and not lost on Mitchell, and he developed specific methodologies including clinical research, autopsy and microscopial investigation to understand and classify these different neural maladies.

[70] Silas Weir Mitchell, George Morehouse and W.W. Keen, *Gunshot Wounds and Other Injuries of Nerves.* (Philadelphia: J.B. Lippincott and Co., 1864) p. 13.

[71] Ibid. pp. 137-138.

considered to be his study, description and treatment of injuries of the peripheral nerves and of the central nervous system.[72]

The first significant study based on the research from Turner's Lane was on reflex paralysis (Circular No.6), which focused on cases of sudden palsy as a result of wounds in remote regions of the body. This was followed by *Gunshot Wounds and other Injuries of the Nerves,*[73]which was based on 2000 pages of notes taken over two years.[74]In accounting for the development of medical specialization in the nineteenth century, it is very significant that these first publications outlined in detail their methodology, including diagnosis and treatment and were illustrated by a large number of Civil War case studies. It is also significant that their findings were so widely distributed during the war. Surgeon R. Weir wrote the Surgeon General's Office in 1864 requesting one hundred copies of the Circular, which was to be distributed among medical officers.[75] Mitchell described this work as putting forth a "novel symptomology for nerve injuries"[76] which added a large number of interesting facts in regard to "nutritive changes in joints, skin, nails and hair."[77]He also prescribed certain forms of treatment for these cases including the local use of massage,[78] injections of atrophia for spastic states, which he described as the first hints as to ascending neuritis.[79]Other subjects of interest included epilepsy, malingering[80]and muscular hyperaesthesia. Patients who were sent to Turner's Lane were a prized clinical resource and instrumental in the development of this new specialty. Neurological study was so new to the examiner that it was often the patient's

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[72] Merritte Weber Ireland, Biographical Sketches of Jefferson Medical College Graduates who Served in the Civil War, National Library of Medicine MS B 169.
[73] Published in 1864 and expanded in 1871.
[74] Silas Weir Mitchell Papers, 1850-1928 MSS 2/0241-03, Series 7.5
[75] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870. Entry 12, Box 67, Letter to Barnes from R. Weir May 28, 1864.
[76] Because of the scope of cases during the war, very particular headings were adopted to organize the research. These included: Primary effects of Wounds and other Injuries of Nerves; Injuries of Nerve Centres; Injuries of Sympathetic Nerves; Injuries of Nerve Trunks or branches, and their results including: alterations of nutrition, lesions of sensation, lesions of motion, alterations of calorification, electric condition of the parts and the treatment of nerve lesions. See, Silas Weir Mitchell, George Morehouse and W.W. Keen, *Gunshot Wounds and Other Injuries of Nerves.* (Philadelphia: J.B. Lippincott and Co., 1864) p. 12.
[77] Silas Weir Mitchell Papers, 1850-1928 MSS 2/0241-03, Series 7.5 Library of the College of Physicians, Philadelphia
[78] By recommending the local use of massage he clearly reconciled localized pathology in his work, but his simultaneous emphasis on functionalism illustrates the co-existence of functionalism and organic localism.
[79] Silas Weir Mitchell Papers, 1850-1928 MSS 2/0241-03, Series 7.5.
[80] The work on malingering is really interesting, and illustrates well the use of patients as a resource to develop medical knowledge. The best article (largely written by Keen) is, Keen, W.W., Silas Weir Mitchell and George Morehouse "On Malingering, Especially in Regard to Simulation of Diseases of the Nervous System." *American Journal of Medical Sciences* 48 (1864): 367-94. In the interest of space and also the absolute draconian way in which the patients were tested for illness, this subject will be covered in chapter four.

complaints that influenced the course of treatment adopted by the physicians. As Mitchell remarked:

> Should it be asked how so full a knowledge of these early phenomena was attainable off the battle-field, we reply, that the utmost care was exercised in ascertaining from the patient the state of his functions, and that it was common to find that wounded men who are not weakened by loss of blood or excessive shock have a very natural curiosity as to the condition of the wounded part, and are apt almost immediately to handle it, and to try to move it.....The large mass of our patients being Americans, they were usually possessed of at least some education, and often of considerable intelligence and power of observation, which was certainly not dulled by the interest with which some men regarded their own cases.[81]

The cause of the various disorders did not vary significantly. Those suffering from nerve wounds were often men "worn out from fever, dysentery and long marches" or of course gunshot wounds and all provided a unique opportunity to study a variety of nerve injuries, which Mitchell described as "very intense."[82]The patients were primarily convalescents and suffered from a range of awesome wounds including being shot "directly through the posterior of both eyeballs" or "necrosis of a large part of the body of the cervical vertabra" where the "sequestrum discharged through the mouth, showing the anterior portion of the foramen for the transmission of the vertebral artery."[83]

Martin Anz of Co. B 68 New York volunteers was shot with a musket ball round the back side of the left leg at the Battle of Bull Run on August 30, 1862.[84]It was determined that the ball must have injured the head of the fibula and then lodged in the head of the tibia. After the initial case history, a clinical picture was soon established and generally included "the first impressions of the individual so injured, the nerves wounded; the amount of shock, and the extent of primary derangement of the functions of motion and sensation."[85]The patient informed Mitchell that he fell upon being hit and was unable to walk, but on trying found that he could flex and extend the foot. Anz was sent

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[81] Silas Weir Mitchell, George Morehouse and W.W. Keen, *Gunshot Wounds and Other Injuries of Nerves.* (Philadelphia: J.B. Lippincott and Co., 1864) p. 20.

[82] Silas Weir Mitchell Papers, Library of the College of Physicians, Philadelphia Box. 17 Series 7. MSS 2/0241-03 p. 20. "The Medical Department during the Civil War: Address before the Physicians Club Chicago, Ills. 1902/March/25."p. 38.

[83] William Williams Keen, "Surgical Reminiscences of the Civil War" in *Addresses and Other Papers* (W.B. Saunders & Company, 1905) p. 438.

[84] Silas Weir Mitchell Papers, Turner's Lane Hospital Case and Follow up Studies 1863-1892. Cage Z 10/40. Library of the College of Physicians, Philadelphia.

[85] Silas Weir Mitchell, George Morehouse and W.W. Keen, *Gunshot Wounds and Other Injuries of Nerves.* (Philadelphia: J.B. Lippincott and Co., 1864) p. 13.

to Ebenezer Hospital in Washington on September 6, where he underwent several operations to extract the ball, which was finally removed in December, 1862. His leg lay in a fracture box for six weeks, during which time a surgeon united the wounds of exit and entry by an incision, which according to Mitchell "probably implicated the tibial nerves" or it was the changes in the ball track because after weeks "he had lost all power to extend the foot."[86] After he was sent to Turner's Lane, it was observed that it was the pressure on the "muscular cutaneous nerves" and on the "front of the tibia below the wound" which caused shooting pains in the foot. The patient suffered "great pain walking" and there was burning and swelling in the foot. Anz was diagnosed as suffering an injury to the tibial nerve leading to "paralysis of extensions of foot." The diagnostic test and treatment employed by Mitchell was electricity, which he used for the purpose of exercising muscles in persons at rest.

European neurologists began the development of medical electricity in 1849 when Duchenne used the induced "faradic" current and in 1856 when Robert Remak used the primary "galvanic" current, whose publications became the source of much interest during and after the Civil War among those interested in neurology.[87] Very few physicians were familiar with electricity as a form of treatment during and immediately following the war, which supported the idea of a "neurological specialist" by assigning "expert" status to those who were familiar with the treatment and the equipment. As Blustein argues, however, the use of electricity had also previously been associated with quackery until it was determined that "electricity has deservedly won a position in legitimate therapeutics."[88] This was in large part because the "value of the remedy had been tested and proved by men whose motives are beyond mistrust, who are as thorough clinicians as they are accomplished scientists."[89] The work performed during the war did much to garner support for electricity as effective in the treatment of the various nerve disorders.

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[86] Silas Weir Mitchell Papers, Turner's Lane Hospital Case and Follow up Studies 1863-1892. Cage Z 10/40 Library of the College of Physicians, Philadelphia.

[87] Blustein, *Preserve Your Love of Science*, p. 128. She shows that Hammond was one of the first people to introduce the works of Duchenne and Remak in the United States. See also Silas Weir Mitchell, George Morehouse and W.W. Keen, *Gunshot Wounds and Other Injuries of Nerves*. (Philadelphia: J.B. Lippincott and Co., 1864) p. 137. They discuss Duchenne's theories.

[88] In discussing electricity, Mitchell referred to its controversial status when he said, "one of them, and the most efficient, is perhaps the most overrated and underrated of all the medical armamenta. Need we add that we refer to electricity?" See, Silas Weir Mitchell, George Morehouse and W.W. Keen, *Gunshot Wounds and Other Injuries of Nerves*. (Philadelphia: J.B. Lippincott and Co., 1864) p. 136.

[89] New York Medical Journal early 1870 quoted in Blustein, p. 129.

It was once again an opportunity to orient medicine along the same lines as in Europe since there was a new environment in which to experiment and test certain theories and therapeutics that had once only been accessible overseas or in print. Mitchell was extremely pleased to be able to undertake "numerous and elaborate researches" to "test and verify" Duchenne's views.[90]As Mitchell observed in regards to electricity, "as respects its value in traumatic lesions of nerves, we feel constrained to state that it has been understood and rightly appreciated by M. Duchenne alone.....After a year of great experience in the use of electricity, we are still satisfied of the essential correctness of almost every proposition on the subject which the distinguished physician has laid down."[91]In addition to adopting a more widespread use of electricity, Mitchell also advocated some newer treatments based on his Civil War experience, including a combination of rest in conjunction with massage[92]and over-feeding.[93]

In the case of Martin Anz, Mitchell prescribed the electric test in order to determine his response to electricity. Mitchell wanted to exercise the muscles with the least amount of pain, and to do this he used an "induction current, with interruptions as slow as one every two to five seconds."[94]By restoring or testing the function of the various muscles with electricity, the physician could determine whether neural connections could be remade (thus "recall to functional life the muscles"),[95]what muscles could recover, or whether muscles had lost all ability to respond to electric properties. The use of electricity helped to determine both the extent of the damage and the course of treatment. It was, however, complicated and Mitchell advised that it should be done by a "clever operator who knows his anatomy well" and who "may need experience to manage them so as not to shock and disgust the patient by inflicting needless pain."[96]It was found that Anz suffered slight sensibility on his calf and extensors but on the front of the leg

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[90] Silas Weir Mitchell, George Morehouse and W.W. Keen, *Gunshot Wounds and Other Injuries of Nerves.* (Philadelphia: J.B. Lippincott and Co., 1864) p. 142.
[91] Ibid. p. 136. Electricity, however, gradually falls into disfavor (especially by the 1880s). See Blustein, p. 131.
[92] Especially for use in cases of spinal and local disease to restore function.
[93] For a full description of his treatments, which were perfected during and after the war see, Silas Weir Mitchell, *Fat and Blood: An essay on the treatment of certain forms of Neurasthenia and Hysteria* (Philadelphia, 1899). The entire book deals with therapeutics for neurological disorders and was highly popular as a guide in America and Europe; reprinted over 10 times.
[94] Silas Weir Mitchell, *Fat and Blood: As Essay on the Treatment of Certain Forms of Neurasthenia and Hysteria* (Philadelphia, 1899) p. 67.
[95] Silas Weir Mitchell, George Morehouse and W.W. Keen, *Gunshot Wounds and Other Injuries of Nerves.* (Philadelphia: J.B. Lippincott and Co., 1864) p. 140.
[96] Ibid.

and on the outside, "dry conductors gave burning pain on the skin."[97]By July 15 the patient was "much better" and by January 12, 1864 it was noted the patient had been acting as ward master, had been on furlough twice and was finally placed in the invalid corps. On his last visit, Mitchell measured Anz's calves, checked the sensation of the leg, and the motion of the foot in which he found "full extension of the foot, but not flexion, no extension of the great toe, and no adduction."[98]He further found after performing an electric test, "absence of muscular contractibility in the f. annicus and p.congus" the "electrical sensibility lessened" but with "excessive muscular contractility in the calf muscles, which are liable to painful cramps at all hours, and on using electricity."[99] Mitchell found the amount of contractibility under faradization to be a good test as to the condition of the muscle (which he compared to healthy corresponding organs); if it appeared similar to the healthy organ, the chance of future volitional control was more likely.[100]Mitchell's work influenced a few doctors in the general hospitals, who were also undertaking experiments with electricity. D.W. Bliss, surgeon in charge of the Armory Square Hospital in Washington conducted experiments with Dr. Leon also at the hospital. He reported to Hammond in April, 1863:

> Dr. Leon has been applying electricity and vapor baths in several chronic cases of rheumatism, paralysis, local hyperesthesia and cutaneous diseases to patients in this hospital that had previously resisted every remedial means applied for their relief. Several of these cases have improved rapidly under his treatment and especially one case of contraction of the muscles of the thigh that has rapidly improved, and now promises a speedy recovery. Several cases of malingering have been detected by means of his electrical appliances, and the men returned to duty thereby greatly benefiting the public service.[101]

Mitchell, Morehouse and Keen's work on reflex paralysis was among the most interesting contributions to the developing specialty. The symptoms of reflex paralysis closely mirrored injuries to the spine, which led to detailed clinical symptoms for each affliction.[102]For example, did the ball pass over the spine causing loss of motion or shock,

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[97] Silas Weir Mitchell Papers, Turner's Lane Hospital Case and Follow up Studies 1863-1892. Cage Z 10/40 Library of the College of Physicians, Philadelphia.
[98] Ibid.
[99] Ibid.
[100] Ibid.
[101] RG 112 (NARA) Central Office Correspondence, Entry 7, Box 12. To Hammond from D.W Bliss; April 9, 1863.
[102] Whether it was a "nerve concussion" or a "direct wound" each disease presented different and ultimately well defined symptoms—once again a benefit of having so many cases to study and compare.

or were large nerve trunks or sensory nerves encountered? They found in their research that if a ball passed the sciatic nerve and palsied the limb, even at a distance of an inch, the immediate effect could be the same as if the nerve itself had been hit. The delineation of this similarity actually helped Mitchell, Keen and Morehouse better understand nerve disorders within the context of the pathological-physiology of the body. Their work on peripheral injuries was very exciting. In 1864, Brown Sequard delivered a lecture at the Smithsonian Institution about diseases of the nervous system and highlighted the work at Turner's Lane:

> Dr. Weir Mitchell a physiologist of Philadelphia has published recently a number of cases of this sort. But I mention here that Dr. Mitchell's cases are not strictly speaking cases of reflex paralysis: they are cases in which central inflammation or at least congestion of nerve centers was excited by the peripheral injury and in which the paralysis in the distant part was immediately dependent, not upon the injury to the nerve, but upon the congestion or inflammation which it has caused. Hence in these cases the treatment of reflex paralysis failed.[103]

There were some effects of nerve wounds that neurologists knew very little about. For example, when the ball had gone through the neck (back to front or front to back), which is so rich in nerves, could that cause the spinal column to be concussed at the side? Could paralysis of the arm result from the shaken spine or concussion of the spinal nerves at their exit, or are nerves in the lower tissues of the neck causing the paralysis? They did not know fully the damage (temporary or permanent in the body) which would be caused by the destructive minie ball.[104]They recommended a specific methodology to answer these questions which were of "much clinical interest." First, they advocated a "careful study of these singular cases in field hospitals, with special reference to the parts implicated in the wound, and by an anatomical examination of recent wounds in men who have been slain."[105]With this examination they advised physicians to "minutely ascertain, by ocular and microscopic examinations, how far around the ball track there is injury of tissue" including examining the damage to the "bone, nerve, and muscle" to which the ball may have come into contact. They further advised, if possible, that physicians should conduct experiments and elucidate the facts that would help to "clear up a subject that has

[103] RG 94 (NARA) Reports of Diseases and Individual Cases, File A 344, Entry 621. "Notes of a Lecture by Dr. Brown Sequard Delivered at the Smithsonian June 14, 1864."
[104] Silas Weir Mitchell, George Morehouse and W.W. Keen, *Gunshot Wounds and Other Injuries of Nerves.* (Philadelphia: J.B. Lippincott and Co., 1864) p. 36.
[105] Ibid.

never yet been rightly studied, and would probably lead to most valuable results."[106]This prescription well illustrates the methods under which neurology developed during the war. The specialists at Turner's Lane identified the limitations in their knowledge and constructed research questions and strategies that could be acted upon by doctors not previously acquainted with nervous disorders. It did not mean everyone who read Mitchell, Keen and Morehouse's publications would become an expert; rather it helped ensure that neurological study would engage physicians who encountered nervous disorders by providing instructions on how to understand nervous diseases, which helped garner more widespread recognition of neurology as a specialty. This would later translate into changes to medical school curricula and other forms of institutional support for neurology such as the Neurological Society, which was founded in 1875.

During the war there was no shortages of cases in which to identify prevailing problems and research questions. On December 13, 1862 Jacob Demuth, a Swiss immigrant of Co. D 108 New York Volunteers, received a shell wound to the right thigh at the Battle of Fredericksburg. He was marching double quick when a fragment of shell as large as musket ball struck his right thigh at the junction of his upper and middle third directly over the femoral artery.[107]The fragment did not enter deeply, but lodged in the leg and was removed a day later without injury to the vessel. The patient felt a burning pain in "both feet and the right arm in front of the right chest and in the right thigh above the wound" and while the power in his left arm slowly returned he was "paralyzed as to motion in his right arm and both legs."[108]The loss of voluntary control and sensation generally followed all "grave wounds of nerves."[109]These were considered to be direct nerve wounds probably caused by the passage of the ball. The question to answer was if the loss of function was caused by actual contact with the nerve; when there was no possibility that the nerve was touched, the loss of function was attributed to local shock.[110] Mitchell found the condition of local shock "very curious." If the ball passed <u>near</u> the sciatic nerve, for example, the limb would be instantly paralyzed with volitional

[106] Ibid. p. 36.
[107] Silas Weir Mitchell Papers, Turner's Lane Hospital Case and Follow up Studies 1863-1892. Cage Z 10/40
[108] Ibid.
[109] Silas Weir Mitchell, George Morehouse and W.W. Keen, *Gunshot Wounds and Other Injuries of Nerves.* (Philadelphia: J.B. Lippincott and Co., 1864. p. 17.
[110] Ibid. p. 18.

control returning after about a week.[111] But Mitchell was perplexed about the relationship between loss of motion and loss of sensation,[112] which did not equally damage motor and sensory fibres. This apparent contradiction directed his research which examined whether "the fibres of motion and sensation may be grouped in bundles, and thus be liable to insulated disturbance" or whether to the "two orders of nerves some difference in constitution or sensitiveness to foreign impressions, makes one more liable to suffer than the other?"[113] He used the cases under his care to research and experiment with the various phenomena he could not reconcile.

While Demuth's wound was healing it was observed that he had a headache, which lasted for about four weeks; he did regain the power to move his right arm, though feebly and slowly, but could not stand on his left leg. By January 25 he was sent to Washington where he was able to walk with the help of a cane but soon suffered a relapse in which the paralysis increased. On June 4 he entered Christian Street Hospital, to be treated by Mitchell, who conducted a number of tests including checking his nutrition, sensation, tactile sensation and range of movement. Mitchell examined Demuth's movement and found that the patient had some power to move the thighs when lying down, but could not lift his legs from the bed. He had no motion below the knee, with the exception of some movement in his toes. Pressure on the cicatrix caused "feeble twitching of the anterior muscles of the right thigh" and both legs were "subject to cramps and twitching which increase at night."[114] Mitchell then studied sensation, and found the patient suffered from "shooting pains" at the seat of the wound, "darting from the thigh to the knee" with a burning sensation in both feet and pressure or pinching of the muscles gave him "more than the usual pain" causing Mitchell to believe he had hyperaesthenia of common sensation. Lastly he measured nutrition and found no special atrophy of individual groups of muscles but both legs were "slightly wasted," the legs

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[111] Ibid. p.18.

[112] But he generally found that with the paralysis of the nerves that motion was more frequently impaired then sensation.

[113] Ibid. pp. 18-19. He did reconcile his views to the anatomy of the brain noting, "all of our anatomical views incline us to the belief that the two orders of nerves are intimately blended in the large nerves." Which troubled him because if this were so he wondered, why would one set escape the loss of function which the missile inflicted on the other? This work was so interesting because it challenged Mitchell's basic assumptions about the body's function, while also outlining specific research (or problem) areas for future neurologists to investigate.

[114] Silas Weir Mitchell Papers, Turner's Lane Hospital Case and Follow up Studies 1863-1892. Cage Z 10/40 Library of the College of Physicians, Philadelphia.

below the knees were congested but not swollen and the muscles of the legs were "irritable to induced electric currents."[115]The patient was diagnosed as suffering from reflex paralysis and was first ordered to have "rough fricheons with cold to the spine" and to take a twentieth of a grain of strychnia" three times daily; however under this treatment the cramps and twitching increased so that after three weeks the strychina was "finally laid aside as useless or worse." About the middle of August Mitchell placed a blister on the cicatrix with the "effect of greatly relieving the burning in both feet." At the same time the patient was ordered to use the hot and cold douche to the spine alternatively. Electricity was continuously employed during the two months, and a month later he was also treated with iron and quinine. It was observed that the electric treatment caused a "rapid amelioration of his case" and that he "soon left his bed and began to walk on crutches"; however, by early November the treatment was abandoned after the patient "ceased to improve." At this time it was observed that he could use his right arm well and walk unaided although with a little unsteadiness of gait. In early December, Mitchell examined the patient's motion, sensation and the level of pain.

Mitchell's interest in pain as a symptom of nerve disorders affirmed his commitment to the production of new forms of scientific knowledge. He found that the immediate effects of shot injuries to the nerve was pain "not generally felt locally, but at some point in the distribution of the nerve—in completely divided nerves; total loss of sensation in the parts supplied by it; shock more or less profound, proportionate to the reflex disturbance; and paralysis of motion and sensation, complete or partial."[116]He recognized that it was not the most important symptom, but because it was reported upon so frequently and prominently he made special examination of its phenomena. He found three types of pain: neuralgic, aching or burning, noting that they sometimes mingled. Pain was found to be caused by either the scar or the nerve tracks and was treated with "frictions over the cicatrix, with moderate exercise of the part," the use of leeches placed over the nerve, the application of blisters or cautery, along with hypodermic injections of morphia.[117]Burning nerve pain (later called causalgia) which was the more "formidable

[115] Ibid.
[116] *Medical and Surgical History of the Rebellion* Part III, Vol. II p. 725.
[117] Silas Weir Mitchell, George Morehouse and W.W. Keen, *Gunshot Wounds and Other Injuries of Nerves.* (Philadelphia: J.B. Lippincott and Co., 1864) p. 146.

symptom," forced Mitchell, Keen and Morehouse to exhaust their "ingenuity in devices for its relief;"[118]this eventually consisted of isolating the starting point of the pain, which was found to lay in some "altered state of the ultimate nerve fibres and connected with the defective nutrition of the part."[119]They treated burning pain by blistering the seat of pain with Granville's lotion,[120]followed by a cantharidal ointment or cantharidal collodion, and morphia injected once a day. Mitchell later observed that although cases of burning neuralgia "were received in England with critical doubt," he did not doubt the validity of this reaction, noting that it was often so intense that in one year "over forty thousand injections of morphine were used."[121]

In the case of Jacob Demmuth, Mitchell noted that there was an "absolute loss of sense of pain in the right leg, belly chest, and arm"; so complete was this "analgesia that the most intense use of the nails on the right hand or the right nipple caused not the least sensation." As was standard practice, Mitchell measured the patient's temperature in the leg and foot and found that "higher heat caused reflex movements which did not tend to remove the limb from the irritant, but were merely convulsive in their character" while intense cold also gave rise to these irregular movements. The importance of communicating with the patient and the doctor-patient relationship in the development of this specialty is evident in Mitchell's final note. As he employed the electric test he found some difficulty in determining the state of the muscles as to their electric sensibility "owing chiefly to the want of intelligence on the patient and to the fact that he spoke an impure German patois which made it no easy task to obtain from him a clear statement of his feelings."[122]He then observed that the electro muscular contractibility was found slightly diminished in the right leg and arm, and it is much impaired in the extensors of the toes on both sides. Everywhere the muscles responded slowly, but active and passive

[118] Ibid. p. 147
[119] Ibid.
[120] A counter irritant, excited in a part of the body to produce an irritation, designed to relieve one existing in another part of the body.
[121] Silas Weir Mitchell Papers, Library of the College of Physicians, Philadelphia, Box. 17 Series 7. MSS 2/0241-03 p. 20. "The Medical Department during the Civil War: Address before the Physicians Club Chicago, Ills. 1902/March/25." p. 39.
[122] Silas Weir Mitchell Papers, Turner's Lane Hospital Case and Follow up Studies 1863-1892. Cage Z 10/40.

movement was restored and with the douche, iron, quinine and liberal diet the patient was "relieved" and discharged on December 14, 1863.[123]

Mitchell, Keen, and Morehouse's investigations also produced novel results related to the study and management of epilepsy. Mitchell noted that their notes on epilepsy "were very full, and there were things recorded which I have never seen since or seen but once, and are worth a mention."[124]It is extremely interesting that the physicians at Turner's Lane used experiments designed in the hospital to direct medical practice. As Mitchell recalled, "in certain cases of epileptic status and sometimes in others, we could bring on epileptic attack by pressure on the upper subclavicular thoracic region or by pinching the skin in that locality."[125]Hospital work was still relatively new in America and so was the treatment of neurological disorders; however, Mitchell's work had the immediate effect of directing the focus of clinical research. He aimed to provide a reliable, thorough and viable record of the knowledge produced regarding neurological disorders including *how to diagnose*[126]and the effects of the treatments employed (which were still very experimental at this stage). He laid a foundation for clinical research by using his expertise to produce a "blue print" of how to conduct neurological research and as requested in Circular No. 5, they enthusiastically transmitted the knowledge generated from their research:

Keeping in view the divisions here laid down, we shall treat each head of our subject in turn, illustrating every important detail with such cases as represent it in the most striking manner. Our materials for this study consist of about one hundred and twenty cases, all of which have been carefully reported in our notebooks during the past year. No labor has been spared in making these clinical histories as perfect and full as possible.[127]

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[123] Being discharged did not always mean being cured. There were a number of cases that did not respond to treatment and were no longer of value as research subjects and they were discharged (sometimes to general hospitals where other conditions needed to be treated).

[124] Silas Weir Mitchell Papers, Library of the College of Physicians, Philadelphia, Box. 17 Series 7. MSS 2/0241-03 p. 20. "The Medical Department during the Civil War: Address before the Physicians Club Chicago, Ills. 1902/March/25"p. 38.

[125] Ibid. Mitchell also notes that this is exactly what "Brown-Sequard found in guinea pigs suffering from artificially induced epilepsy." It is quite revealing that the same experiments performed on animals in Europe were performed on humans during the war, which highlights the importance and uniqueness of having access to bodies for the production of medical knowledge.

[126] This is a very important point. He produced detailed publications on exactly what to look for in patients, how they may have acted, what they looked like, how to treat etc. This was a new specialty that most doctors were not familiar with, and this work provided an excellent guideline on how to navigate the new specialty.

[127] Silas Weir Mitchell, George Morehouse and W.W. Keen, *Gunshot Wounds and Other Injuries of Nerves.* (Philadelphia: J.B. Lippincott and Co., 1864) p. 12.

The cases at Turner's Lane provided a unique opportunity not only in the number and range of cases, but in the unrestricted way that research questions could be pursued and the unrestricted access to bodies that informed these questions. Mitchell found the case of J.L. Calvert particularly compelling because of the unusual symptoms. He had been shot July, 1863, one inch to the left of the fifth dorsal spine while loading his weapon and was admitted to Turner's Lane February, 1864. Immediately after being shot, the ball "passed downward, between the bones and superjacent tissues, crossing the spine and emerging three and half inches to the right of the tenth dorsal vertebra."[128]The patient suffered great pain in his back and shoulder, which eventually passed. The more interesting symptom was that "an exquisite hyperesthesia of the shoulder muscles on both sides" developed early in the case. The condition was described clearly by the patient and was found to affect the "subcuticular tissues and muscles, so as to limit motion, owing to the pain it caused and even a "light pressure on the skin gave pain."[129]The patient regained normal range of movement in his right arm although "feeble in power," but he was returned to duty. This case baffled the doctors at Turner's Lane. Mitchell remarked that "this case was so interesting that we were at pains to satisfy ourselves of the verity of his symptoms" and in trying to do so they asked the patient (without sight) to "mark the limits of the hyperaesthetic spaces when tested by drawing a pencil point across the boundary between healthy and over-excitable regions."[130]They also found numerous contusions on his lower spine, which were also found to be a symptom of muscular hyperesthesia. The physicians at Turner's Lane were trying to establish a pattern of symptoms or behaviors, which could be linked to specific nervous disorders. They took thousands of pages of notes and compiled statistics using the symptoms of the patients to direct their focus. They were thus able to determine in this and other cases, for example, that "both cutaneous and muscular hyperesthesia are not uncommon in wounds of nerve trunks as well as spinal injuries."[131]With the benefit of so many neurological cases during the war, the doctors at Turner's Lane could compile fairly accurate statistical analyses of

[128] Ibid. p. 36.
[129] Ibid. p. 37.
[130] Ibid.
[131] Ibid.

their research, which enabled them to verify their theories and produce invaluable knowledge.

One of the ways they contributed to their knowledge was by conducting numerous experiments, one of which was "on the antagonism of atrophia and morphia."[132] Bodies were consciously used as research material in which novel and varied forms of knowledge was produced. The goal of this experiment was to determine the therapeutic relations of atrophia and morphia and the comparative value of remedies used to alleviate pain. They were concerned about the amount of pain experienced by the troops suffering with neuralgia and as a result the "incessant use" of hypodermic injections to manage the pain. It was observed that the "the resident surgeons made every day from twenty to thirty subcutaneous injections."[133]The hospital as a site of clinical research during the war provided an opportunity to stabilize somewhat the conditions of the experiments; in this case it was by confining their study to "the use of the agents by injection only" and because "they were studied by more than a single observer."[134]The physicians were uniquely qualified to offer important insights regarding the results of the experiments: "the information which our notebooks give in regard to the comparative value of remedies used to allay pain, is the result of an almost unexampled experience."[135]They conducted trials with various pain remedies including conia, atrophia and daturia but found morphia or a preparation of opium for subcutaneous use, the most efficacious. They also found that it could be injected anywhere in the body to alleviate pain, the exception being cases of burning neuralgia, which were relieved only when the morphia was injected near the site of pain. The central focus of their experiments was to examine the possible "antagonistic influences of morphia and atrophia."[136]They conducted experiments on soldiers who were being treated for painful neuralgic diseases or other

[132] S. Weir Mitchell, W.W. Keen and George Morehouse "On the Antagonism of Atrophia and Morphia, Founded upon Observations and Experiments made at the U.S.A Hospital for Injuries and Diseases of the Nervous System" *American Journal of the Medical Sciences* (July, 1865): 67-76. This article is also very political; they recognize the importance of having animals to experiment upon, but they also want to show how valuable it is to have human subjects for their experiments suggesting their results are very significant and rare—but because the knowledge would benefit others patients the methods were nicely justified.

[133] Ibid. p. 68.

[134] Ibid.

[135] Ibid.

[136] Ibid. p. 69.

afflictions causing pain. After subdermal injections of the two medicines were tried, sometimes conjointly, sometimes in succession they found:

> The results of these observations so interesting and so puzzling, that we finally entered upon a deliberate course of experiments with the attention of ascertaining in what respect and to what degree and through what periods of time, the two drugs in question were antagonistic. While the final conclusions thus reached by us have served in a measure to strengthen the belief in the mutual power of these agents to counteract one another in the economy, they have also brought to light a range of very curious facts, which we think are novel, and which could certainly not have been learned from any course of experiments upon animals lower than man.[137]

They elucidated the importance of having patients who could reveal all of their symptoms, not just the visible ones, which could only truly be ascertained "by the statements of the person who feels them." Mitchell tried to inject morphia into dogs by way of comparison and found the symptoms did not "correspond accurately to those which occur under like circumstances in man."[138]The publication built on the previous works of Brown-Sequard and William Norris, assistant surgeon at Douglas Hospital, who had separately conducted studies confirming the antagonism of atrophia and morphia. The questions Mitchell, Morehouse and Keen addressed, however, were constructed on the basis of having patients as a resource for their inquiries.[139]They examined whether the two agents had different effects on circulation and if so, did one neutralize the other?[140]They studied the effects of morphia and atrophia on circulation and in attempting to answer the questions, injected the agents subcutaneously after which the patients were closely monitored while the doctors looked for any effects on circulation. They then examined the effect of the agents by studying the eye (looking for pupil dilation), then the effects of the drugs on cerebral function (looking for headaches, spasms, visual defects, partial deafness, drowsiness and nausea), finally the effect of the agents on the bladder and to what degree each of the agents controlled pain. After an exhaustive clinical study they published the following conclusions as a guide for physicians: conia, atropia and

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[137] Ibid.
[138] Ibid. Though he did mention how much he liked study the toxicological effects of poisons on cold blooded creatures. But ultimately they wanted to see the influence of medicinal properties "upon the being to whom finally it is to be of medicinal value." Once again, the focus of this paper is on the history of medical practice not medical ethics.
[139] Brown-Sequard, for example derived his opinions from research and experiments with animals.
[140] S. Weir Mitchell, W.W. Keen and George Morehouse "On the Antagonism of Atrophia and Morphia, Founded upon Observations and Experiments made at the U.S.A Hospital for Injuries and Diseases of the Nervous System" *American Journal of the Medical Sciences* (July, 1865): 67-76. p.71.

daturia have no power to lessen pain; morphia was the most effective agent for relieving neuralgic pain, especially when injected near the seat of pain; morphia had little effect on the pulse, while atropia lowered the pulse a little and then raised it within a few minutes and as regards to circulation they did not counteract one another: both agents were mutually antagonistic to the eye with atropia acting much longer than morphia.

Their investigations into the cerebral symptoms revealed that the symptoms caused by either drug "are capable of being overcome by the other" but this was difficult to achieve since the drugs affected the system at different rates (the difficulty was compounded by atropia's "greater duration of toxic activity.") Atropia relaxed the bowels while morphia had the opposite effect; the nausea caused by morphia was not prevented by atropia; both agents caused incontinence; atropia did not alter the power of morphia to relieve pain and finally, in considering the toxic effects on the cerebral organs, it was found that the "two agents were mutually antidotal" but this "antagonism does not prevail throughout the whole range of their influence so that in some respects they do not counteract one another."[141] The most important finding was that as a remedy for pain, morphia would not be counteracted by atropia. In treating painful cases of neuralgic suffering it was of great practical importance for them to determine this fact. As they observed, "if atropia lessens or destroys the unpleasant influence of morphia on the cerebrum, but does not alter its power to allay pain, there seems to be no reason why we should not use them together so as to obtain all that is best from morphia with the least amount of after discomfort."[142] This detailed description of their experiments illuminates the environment in which medical specialization evolved. There was a practical concern: the soldiers who were fighting for the Union were suffering and Mitchell, Morehouse and Keen could help alleviate this pain by finding answers in their research. By publishing the work, this knowledge was transmitted with the intention that it would be used by those working in the general hospitals and lastly, the many patients (or perhaps subjects) under their care enabled the physicians at Turner's Lane to conduct controlled and thorough clinical studies incorporating a broad range of research questions. This would help future

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[141] Ibid. p. 76.
[142] Ibid. p. 75.

neurologists understand how to investigate, manage and treat patients with neurological disorders, laying important groundwork for this new specialty to develop.

Another novel and unique aspect of this work was its role in the formation of the modern doctor-patient relationship. Rather than never seeing these men again, Mitchell established a unique and on-going relationship with his patients, which is probably what informed one of his postwar research projects: the relation of pain to weather. The on-going association with these patients represented one of the earliest longitudinal studies on neurological disorders in America. Many of his former patients were scattered across the country after the war, which prompted Mitchell to examine the effect of weather patterns on neurological disorders and he compared clinical and experimental results. This project first took shape when a number of his former patients sent him letters complaining about pains in wounds that had been sustained during the war. After contacting the meteorological office, he conducted a study in which he tried to reconcile his patients' symptoms of pain with various weather patterns. He looked specifically at waves of rain and found the rain area and pain to be concentric, thus linking symptoms of pain with climate disturbance.[143]Mitchell also examined the influence of nerve lesions on local temperatures, again with the aim of comparing clinical and experimental results. He found that nerve sections cause "fall and then rise of local temperatures, so also does thorough freezing of a nerve."[144]To know if the rise after section was due to the "direct influence of nerves" or to the "vasal dilatation," he emptied his "own arm of blood by a bandage, put on a tourniquet and then froze my ulnar nerve at the elbow." He found no rise of temperature and when the blood was let back in "the thermometer rose above the normal in the ulnar territory."[145]In the relation of pain to weather, Mitchell studied the relation of traumatic neuralgia of the stump to air, temperature, humidity showing that storms were responsible for a large percentage of attacks of pain and discomfort of the stump.[146]

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[143] Silas Weir Mitchell Papers, 1850-1928 MSS 2/0241-03, Series 7. Reprinted in *Nature*, January 1, 1914.
[144] Silas Weir Mitchell, Influence of Nerve Lesions on Local Temperatures: Comparison of Clinical and Experimental Results" *Archives of Scientific and Practical Medicine* (1873) Vol.1 p. 351.
[145] Ibid.
[146] Silas Weir Mitchell, Relation of Pain to Weather: Case of Captain Catlin. *American Journal of the Medical Sciences* (1877) Vol. 1 (xxiii) p. 305.

He also conducted with his son John K. Mitchell, assistant physician to the Orthopedic Hospital and Infirmary for Nervous Diseases, Philadelphia and Lecturer on Physical Diagnosis in the University of Pennsylvania, numerous follow-up studies of Civil War patients who had suffered nerve injuries. In October of 1892 they sent letters to Mitchell, Keen and Morehouse's former Civil War patients and also placed an advertisement in the Washington Post looking for potential subjects.[147]In particular they requested information about the present health of their former patients hoping to compile a more comprehensive picture of nervous diseases. They asked about sensation, heat and cold, range of movement, atrophy of the limb, color of secretions from the injured parts, odors, changes to nails and any other bodily changes that could be a result of the injury. Mitchell further directed that should patients have any trouble answering the questions, that they should show a physician his letter and "ask him carefully to go over your case....I am so well known that I'm sure any one will do me this kindness, because I desire in the interests of medicine and science to get an exact account of your case, and if you desire it, you too could have a copy of the paper when it is printed."[148]Clearly some of his former patients were excited to once again contribute to the development of medical science or receive medical treatment; John Shaw Billings later remarked that "many would go by the medical museum with their addresses for Mitchell."[149]Mitchell received a number of very fascinating letters from soldiers who had apparently been wounded during the war. For example, L.S. Benton wrote Mitchell in October, 1892:

> Learning that you take somewhat of an interest in soldiers I write you regarding myself. I understand you have paid considerable attention to nervous diseases. I was shot through the lungs and my spine was fractured at Antietam. For many years the wound was kept open and I cough some and that lung is very susceptible to cold. My greatest trouble however is nervousness and insomnia for which I have suffered extremely for the past 17 years. I have been treated by all the specialists in Chicago where I formerly lived and I though I am much better, I am far from well. I have called on you on two different

[147] Once again the patient's interests or privacy were subsumed for the good or advancement of the profession. For more on this theme see, Michel Foucault, *The Birth of the Clinic: The Archaeology of Medical Perception* (London, 1973). Clinical medicine is shown to lead to new ways of seeing the body and disease, and new forms of doctor-patient relationship (emerging first in revolutionary Paris—but in America, occurring during the Civil War.) Indeed, during the war, hospital medicine became part of a wider structure of organizing knowledge.
[148] Silas Weir Mitchell Papers, 1850-1928 MSS 2/0241-03, Box 11, Series 4. Library of the College of Physicians, Philadelphia Follow up Studies on Patients with Nerve Injuries, October 1892.
[149] Ibid.

occasions in years past but you were abroad. Will you advise me when I can find you, and of your charges.[150]

Many patients also replied to the questionnaire and closed by asking for a copy of Mitchell's upcoming paper:

Your circular received and in answer I would state: The sensation of touch in my arm is more of a prick then a pinch. The hand is always cold and I have little or no feeling except in very cold weather when I will sometimes ache some, to make me feel a touch in the hand or arm it has got to be a strong one if not I will not feel it at all. I have no movement in the hand but am able to bend the arm at the elbow and raise the arm up on a level with my shoulder, the fingers remain closed all the time the same as they were when I left the hospital. In regard to the nails I do not think they grow as fast on the wounded limb, and they appear to have no life in them like the nails on the other hand, they are hard and thicker than the nails on the other hand.[151]

Mitchell along with John K. Mitchell and Edward Martin also conducted a clinical study beginning in September 1893 with the aim of establishing a pattern of conditions among the men who had lost limbs during the war. Having obtained the addresses of such veterans from the Surgeon General, they sent out a letter inquiring about the "date of wound, amputation of limb, character of wound, interval between wound and amputation, symptoms during this period, operation: nature of flaps; symptoms following operation including shock; pain, character, extent and seat of pain (this answer as fully as possible); the extent, duration and recurrence of suppuration; healing when complete; when the artificial limb was first worn; general health; alteration of pulse; body temperature; digestion; intellectual powers; and finally, general disposition."[152]As John Mitchell observed, "the matter is one which has never been investigated, and the only extensive material which exists for its study is among those who were unfortunate enough to lose limbs in the service of their country."[153]The result was a monograph entitled, *Remote Consequences of Injuries of the Nerves and their Treatment: An Examination of the Present Condition of Wounds received in 1863-65,* which according to his father "added a

[150] Silas Weir Mitchell Papers, 1850-1928 MSS 2/0241-03, Box 11, Series 4. Library of the College of Physicians, Philadelphia Follow up Studies on Patients with Nerve Injuries, October 1892. This letter nicely illustrates the great status that Mitchell achieved during the war.
[151] Ibid.
[152] Silas Weir Mitchell Papers, 1850-1928 MSS 2/0241-03, Box 11, Series 4. Letter to Silas Weir Mitchell from John K. Mitchell Sept. 4, 1893.
[153] Ibid.

valuable chapter to our knowledge of nerve injuries."[154]The responses provided excellent material for advancing the knowledge related to the continuing symptoms and the various manifestations of nerve disorders. Once again the patients proved an invaluable resource in the development of neurology. Richard D. Dunphy who had lost both arms seven inches from the shoulder in 1864, for example, provided the following history of his case:

> During this period felt burning sensation of the nerve and weakness, unable to urinate for 2 days after operation, flaps good covered bone, extraordinary pain and burning for about three weeks in the stump, great quantity of pus and twelve pieces of bone or splinter came out in three months. Now red at end of stump, feels like a prick of a pin to touch the stump, more sensitive than other body parts, worst sensation is in winter when they feel chilly and cold; summer weak and faint sensation, can raise both stumps back to the back of my ears, wears an artificial limb but it makes me sweat, twitch and the limb feels shortened.[155]

Similarly, Wesley Jones of Talking Rock Georgia who had lost both of his arms during the war responded:

> Severe pain at the time, circular operation, suppuration severe. Now, general health weaker, hearing impaired, stump is tender, bothered by cold, sensitive to touch, sensibility to heat and cold, can flex and rotate what remains of stump, twitches involuntarily since directly after amputation, feels the hand but it feels like the fingers grew out at the wrist, limb feels shortened.[156]

It was in fact remarkable for the development of neurology to have the patients as a resource in which to expand the knowledge relating to nerve wounds. For example, with this follow-up study the Mitchells learned that patients suffered common and lasting symptoms including pain, sensitivity (particularly to weather), and twitching. They discovered the psychological effects of suffering wounds of this nature, helping to establish a foundation in which theories and treatment of post traumatic stress disorder could develop. For example diagnoses like "traumatic neurosis," "nervous shock," "physical shock" and "neurasthenia" were associated with ideas related to PTSD[157]and

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[154] Silas Weir Mitchell Papers, Library of the College of Physicians, Philadelphia, Box. 17 Series 7. MSS 2/0241-03 p. 20. "The Medical Department during the Civil War: Address before the Physicians Club Chicago, Ills. 1902/March/25" p. 40.

[155] Silas Weir Mitchell Papers, 1850-1928 MSS 2/0241-03, Box 11, Series 4. Follow up Case Studies, Case of Richard D. Dunphy Age 52.

[156] Ibid. Follow Up Case Studies, Case of Wesley Jones. Interestingly, Mitchell was fascinated with the effects of amputation on the body and mind. In 1871 he published "Phantom Limbs," *Lippincotts Magazine of Popular Literature and Science*, 8 (1871): 563-69.He discussed the 'neuralgias" and "spasmodic maladies" suffered by Civil War amputees. He also discussed the soldier's feeling of having a "constant or inconstant phantom of the missing member."

[157] Though this was not recognized as a psychiatric syndrome until 1980. For the best study of PTSD during the Civil War see Eric Dean, 'We will all be lost and Destroyed: Post Traumatic Stress Disorder of the Civil War" *Civil War*

were commented on frequently in both the original case reports and follow up studies. Henry A. Kircher, Belleville Illinois, had his limb amputated on Nov. 27, 1863 after suffering a gunshot wound. In the follow-up questionnaire he responded:

> Lost arm and leg. Type of operation was leg- flap, and arm-circular. Wounded through knee cap and joint and elbow joint both by minie balls. Feels pain in the stump. Never wore an arm prosthetic "too short"; leg worn constantly since 1864. Enjoys good health, but feels inconvenienced and deprived. Sleeps more, thinks his remaining limbs are stronger, sensation to end of bone, changes in weather cause discomfort, still feels lost part, disturbed at night.[158]

Mitchell published continuously on his wartime neurological research, leading to two important distinctions. He is largely to be considered the father of neurology, but most importantly, his clinical approach to the discipline and detailed methodology largely directed approaches to the new specialty.[159]

Cardiac Diseases and the American Civil War:

When Turner's Lane was established in August, 1862 one of the wards was assigned to Jacob DaCosta, which "afforded him a chance for the study of exhausted hearts and other valuable papers."[160]Da Costa was a graduate of Jefferson Medical College followed by graduate training in Paris and Vienna where he first became interested in pathology and internal medicine. He wrote to Hammond on May 9, 1862 offering his services as an "attending physician by contract for one of the military hospitals in Philadelphia."[161]He reported to duty on May 14, 1862 as an acting assistant surgeon at 16th and Filbert Street Hospital.[162]He took an interest in the heart diseases of soldiers while at Filbert and it was noted that he "is the only acting assistant surgeon

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History Vol. XXXVII (1991): 138-53; Eric Dean, *Shook Over Hell: Post Traumatic Stress in the Vietnam and the Civil War* (Cambridge: Harvard University Press, 1997)

[158] Silas Weir Mitchell Papers, 1850-1928 MSS 2/0241-03, Box 11, Series 4. Library of the College of Physicians, Philadelphia Follow up Case Studies, Case of Henry A. Kircher.

[159] Silas Weir Mitchell is remembered by some as a pioneer for his innovative approaches to the treatment of nervous disorders and by others as a chauvinist for his treatment of women. The most famous example comes from Charlotte Perkins Gilman who wrote in 1892 "The Yellow Wallpaper." She was diagnosed with "temporary nervous depression" with a "slight hysterical tendency" (p. 6). Her physician was Silas Weir Mitchell who prescribed his famous "rest cure" which consisted of taking to bed, being secluded from the family, not working or reading and drinking only fatty dairy products. Her husband, also a physician, confined her to a room in their summer home that had Yellow Wallpaper, described by Gillman as "repellent, almost revolting." (p. 9)The story follows her descent into madness as a result of her confinement. See, Charlotte Perkins Gillman, *The Yellow Wallpaper and Other Stories* (Filiquarian Publishing LLC, 1892): 5-33.

[160] Silas Weir Mitchell Papers, , Box. 17 Series 7. MSS 2/0241-03 "The Medical Department during the Civil War: Address before the Physicians Club Chicago, Ills. 1902/March/25." P. 36

[161] RG 94 (NARA) Personnel Papers of Medical Officers and Physicians, 'Medical Officers Files" Box 144, Entry 561, Papers of J.M DaCosta.

[162]Ibid. His contract lasted from May 15, 1862-May 11, 1865.

connected with the hospital who is now performing special duty, and has charge of the ward containing cases of heart disease, his compensation is 80.00 per month."[163]Even after he secured a post at Turner's Lane hospital he continued his association with Filbert Street: "I have the honor to ask that Jacob Da Costa be retained on duty in this hospital as visiting physician. I would request that a new contract be granted him as resident physician believing that his services in this hospital are necessary to the interest of the service."[164]Once again there was recognition of the necessity of having an expert or specialist on staff to treat the cases that were generally beyond the realm of experience or interest of a general practitioner. Many cases were sent to Da Costa's ward at Turner's Lane Hospital, with the presumption he would publish his findings to benefit military medicine. In the context of the war, there was no longer a fiercely competitive environment between GPs and specialists. Most physicians wanted to ensure that the troops were being well treated and properly cared for in the hospitals[165]and since it was the nature of military medicine to compartmentalize, specialization was an extension of military organization. Physicians with a wealth of experience (perhaps those that had trained abroad, held a professorship at a medical school or published extensively in a specific area) may have been appointed as a medical examiner; others may have previously shown an aptitude for surgery, diagnosis, hospital administration or had previous experience with a specific disease, artificial limb construction or embalming and been assigned accordingly. Within the context of the war, specialization was in many ways just another organizational method and was thus supported (or at least accepted) by the majority of American physicians also doctoring in the war rather than contested as it had been prior to the war.[166]

[163] Ibid. Letter to John Campbell Oct. 21, 1864.
[164] Ibid. Letter from B. Knickerbocker to Barnes, Oct. 7, 1863.
[165] Silas Weir Mitchell's devotion to understanding and alleviating pain is a good example of the care and attention specialists conferred on their patients, and because they published extensively and were recognized for their contributions, physicians generally accepted this new category of physicians.
[166] William Rothstein discusses the "hostility of the general practitioners to specialists" in the 1880s, however, during the war there was much less professional animosity between GPs and specialists. This may have been because specialists were elite men in the profession, because the government offered funds and hospital support for these specialties to develop and/or because they were treating unfamiliar diseases, (which was a lot of work on top of their other duties) and they were saving lives and helping ease the discomfort of the soldiers. It was also a relatively open environment, by that I mean physicians could write the surgeon general and ask for a specific post or assignment and if it would benefit science, they were often rewarded with the desired post.

Jacob DaCosta's first publication, partly based on his research at Turner's Lane, was an 1864 treatise entitled *Medical Diagnosis*, written "to furnish advanced graduate students and young graduates of medicine with a guide that might be of service to them in their endeavors to discriminate disease."[167]Like other emerging specialists during the war, Da Costa emphasized clinical observations rather than merely pathological classification as a research guide. He recognized the opportunity to present a clinical classification of the prevailing diseases encountered during the war, and as some of the case reports relating to Circular No. 2 revealed, this was an area in which some American physicians desperately needed further training. Da Costa hoped that his treatise (which was reprinted into nine editions) would be of great benefit for the general practitioner to understand but also to reflect carefully about medical diagnoses.[168] In this first publication, he included a detailed section related to his wartime work on cardiology, which was just under a hundred pages. He produced a general guide on heart disease, which included a detailed analysis of anatomy and physiology, different methods of physical diagnosis (measuring palpitation, percussion and auscultation), symptoms of heart disease and functional disorders and organic diseases of the heart. He provided a complete guide for physicians to understand heart disease with illustrations and graphs to accompany his descriptions essentially creating a foundation upon which to build knowledge. He elucidated this work more fully with his 1871 publication on irritable heart a "cardiac malady" or "functional disorder of the heart" based on the investigation and analysis of at least 300 cases of heart disease seen at Turner's Lane, which he found to be common among soldiers.[169]Although it was a study based on the heart disorders of soldiers, Da Costa noted that it was equally "interesting to the civil practitioner, on account of its intimate bearing on some obscure or doubtful points of pathology."[170]

One of the most compelling features of the work with cardiac patients was the "unusual characters of this disease rather than its frequency which made it the subject of observation and study."[171]DaCosta began calling the heart diseases he diagnosed in

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[167] J.M. DaCosta, *Medical Diagnosis* (Philadelphia, 1864). p. v.
[168] Ibid. vi.
[169] J.M. DaCosta "On Irritable Heart; A Clinical Study of a Form of Functional Cardiac Disorder and its Consequences." *American Journal of the Medical Sciences* (CXXI, Jan, 1871): 17-52.
[170] Ibid. p. 17. He also remarked that he had seen many of the same cases in his private practice.
[171] *Medical and Surgical History* Volume I, Part III p. 862.

soldiers "irritable heart"[172] in 1862 (functional cardiovascular disease), which was very important for the development of this specialty. [173]With this designation, he identified a common but undiagnosed problem among soldiers. He wrote to the War Department to call attention to this "form of cardiac malady," particularly as he observed it after the Peninsula Campaign. This had the important effect of having the medical department formally recognize this problem among soldiers, which they did by sending numerous cases to Da Costa's ward, allowing him "to study the affection on a large scale."[174]Like Mitchell, he continued the association with his patients after the war and found that in waiting to publish he had the "opportunity of ascertaining the sequel to many of the cases recorded. And this, for reasons which will soon become evident, struck me in the examination of the subject as of particular value."[175]Prior to the war, Da Costa's chief understanding of the heart diseases in soldiers came from reading the British Blue Book of the Crimean War in which sixty-two cases were classed as having various heart diseases, and also among the British troops in India.[176]During the Civil War he observed that "irritable heart" was "encountered in every army of the United States and attracted the attention of many of its medical officers."[177]As the physician A.J. McKelway of the 8th N.J. noted after the battle of Williamsburg, May 5, 1862:

Disease of the heart appears to have developed in several cases from overexertion preceding the battle and excitement and effort during its continuance. In these cases the pulse remained for days at 110-120 beats per minute. Some fifteen cases, which have been discharged or sent to the hospital, originated at that time.[178]

Physicians were aware of the great opportunity that these cases represented:

To this day, nowhere, whether as the result of ordinary duties of the soldier or of actual war, has the subject so far as I can find, been made one of careful clinical investigation. It is very possible that from inherent circumstances our war furnished more

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[172] Also called "cardiac muscular exhaustion" by Henry Hartshorne who also studied cardiac affections among soldiers. See, *Medical and Surgical History* Volume I, Part III p. 862.

[173] There were cases attributed to drills and double-quick movements of camp life, or when the soldier was debilitated with diarrhea or typhoid fever, and some were diagnosed with over-action of the heart during or after a battle. See, *Medical and Surgical History* Vol. I, Part III. p. 862 A number of soldiers, for example, were treated for heart disease after the "continued exertion, anxieties and excitement of the seven days' fight from Richmond to Harrison's Landing, Va."

[174] J.M. DaCosta "On Irritable Heart; A Clinical Study of a Form of Functional Cardiac Disorder and its Consequences." *American Journal of the Medical Sciences* (CXXI, Jan, 1871) p. 17

[175] Ibid. p. 18.

[176] Ibid.

[177] Ibid. He also remarked that it was not just observed among troops engaged in actual war but also "soldiers kept long under drill were also liable to functional derangement of the heart with palpitation."

[178] *Medical and Surgical History*, Volume I, Part III p. 862.

material of the kind than is likely soon to be met with again; for so many men called, by the tap of the drum, from civil pursuits, and sent without previous training into the field, is not a state of things likely often to happen.[179]

In accumulating a picture of heart disease, DaCosta began with a detailed clinical history of the cases he encountered, and these were extremely analytical. He found that heart disease generally affected men who had been in the service for at least a few months, the patient usually suffered from diarrhea or fever and had a short stay in a hospital, but after returning to his regiment was often found to be short of breath, dizzy, suffering palpitations (sometimes violent) and pain in the chest (sometimes severe, sometimes dull) at which time he would be proclaimed unfit for duty and sent back to the hospital.[180]The patient's heart would pound quickly, causing "irritation"; sometimes the heart could be brought back to its normal condition while other times it could not be controlled and the soldier was discharged or placed in the Invalid Corps.[181]Some cases of heart disease would appear more suddenly, causing irregularity in circulation and pain in the cardiac region. In these types of cases, DaCosta tested a variety of remedies including tincture of gelsemium; veratrum viride; belladonna or tincture, in the attempt to reduce the pulse. Sometimes oxide of zinc followed by strychnia or digitaline granules would be prescribed along with rest (sometimes for months). The efficacy of the remedies varied from patient to patient and Da Costa kept detailed notes on the remedy used for each; however, he seemed to have had the best results with Morson's digitaline.[182]He published these findings in detail, demonstrating to physicians how to diagnose "irritable heart" and explained the symptoms, which he illustrated with specific case histories. In particular, he discussed palpitation, cardiac pain, often described as sharp and cutting or dull and heavy, where the seat of pain was, and he described the pulse, respiration, nervous disorders, digestive disorders and the urine. He outlined common and unusual physical signs and even the general course of the disorder and the different diagnostic signs for

[179] J.M. DaCosta "On Irritable Heart; A Clinical Study of a Form of Functional Cardiac Disorder and its Consequences." *American Journal of the Medical Sciences* (CXXI, Jan, 1871) p. 19.
[180] DaCosta also comments on the fact that irritable heart probably occurred among men in the southern army. He reasoned that "men of the same race, transformed into soldiers under much the same circumstances" and enduring "more privations, should not have escaped" this affection. J.M. DaCosta "On Irritable Heart; A Clinical Study of a Form of Functional Cardiac Disorder and its Consequences." *American Journal of the Medical Sciences* (CXXI, Jan, 1871) p. 19.
[181] Ibid. p. 19.
[182] Ibid.

"irritable heart." He also discussed causes, which ranged from fevers, scurvy and sunstroke to diarrhea to the more common hard field service and exigencies of a soldier's life. Patients sometimes also complained of "cardiac uneasiness and pain, headache, dimness of vision, and giddiness."[183]He concluded his article with suggested remedies and various treatment options, which is a remarkably detailed description of the remedies he tested during the war.

Like Mitchell, Keen and Morehouse, DaCosta initially focused on the functional disorders of the heart rather than organic affections, a distinction he believed was one "practically of the highest importance."[184]DaCosta's wartime work greatly enhanced his general understanding of functional and organic diseases. He recognized that other physicians also had a difficult time differentiating between functional and organic heart disease. Thus he elucidated his research with case histories for each affliction. The *Medical and Surgical History*, for example, noted that, "of 4901 men discharged for disability....during the early part of 1863, 2,323 cases were certified on the ground of heart disease: 1,123 are said to be organic and 1,200 functional."[185]Surgeon Sanford B. Hunt differentiated between "disturbance of the function of the heart dependent upon causes foreign to the organ itself," and organic disease which manifested as a "valvular murmur, a diffused impulse, an enlarged area of percussion and a friction sound in the pericardium."[186] Hunt observed that "so far as organic disease is concerned the diagnosis of the mere fact is not difficult.....it is only when we come to sub-classify, that diagnosis becomes nice and difficult."[187]

DaCosta recognized this difficulty, prompting him to study these two designations of heart disease more fully. In his 1869 article "On Functional Valvular Disorders of the Heart" he recognized that within the "light of generally existing knowledge" physicians, when making the distinction between organic and functional cardiac affections, "will often be led into error."[188]Thus the war proved to be a

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183 Ibid. p. 22.
184 J.M DaCosta "On Functional Valvular Disorders of the Heart" *The American Journal of the Medical Sciences*, CXV (July, 1869): 17-34.
185 *Medical and Surgical History* Volume I, Part III. p. 864.
186 Ibid.
187 Ibid.
188 J.M DaCosta "On Functional Valvular Disorders of the Heart" *The American Journal of the Medical Sciences*, CXV (July, 1869) p. 17.

particularly important period in DaCosta's career. As patients recovered together in his ward for a long period he was able to make one of his most interesting discoveries, establishing the importance of his work for American medicine beyond the diagnosis and treatment of soldiers. At the root of these investigations was his initial assumption that organic and functional organic affections were "widely separate."[189]Thorough investigations would challenge his initial assumptions about heart disease. His investigations revealed that cases of irritability (rapidly beating heart) could develop into hypertrophy of the heart (increased organ size, caused by inefficient valves or hardening of the heart muscle forcing the heart to work harder), accompanied by a slow and labored pulse and in marked contrast to the rapidly beating irritable heart.[190] He was shocked at this discovery, but as his patients multiplied he "began to trace the connection; and observation showed me…..the links connecting the disorders."[191]Thus based on more than two hundred cases he demonstrated the transition from irritability to hypertrophy. He used the example of William H.S., an infantry man who enlisted in October, 1863.[192] The patient was described as a smoker, a moderate drinker who was in fairly good health at the time of his enlistment. In the first year of service he did "much marching" and was "much exposed." For two months the patient was "frequently attacked at night with smothering or suffocating sensations, and with palpitations; and even prior to this had found it difficult to do his duty, and had signs of cardiac distress." The patient was examined by DaCosta in October of 1864, and he reported that the pulse was "extended and forcible, beating 80 times in the minute; the first sound was heavy; the second only at the base very distinct." The "cardiac percussion dullness was decidedly increased" and he had an occasional "sharp pain over the heart."[193] He was discharged in May, 1865 and DaCosta observed that "the physical signs were unchanged; the large percussion dullness was not in the least modified, and the first sound was noted as heavy and dull at the apex;

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[189] Ibid. p. 21.
[190] He classed heart disease into three categories: he found twenty-eight cases of hypertrophy, one hundred and thirty six cases of functional disorder and thirty six cases in which irritability was passed into hypertrophy. See, *Medical and Surgical History*, Volume I, Part III. p. 864.
[191] Ibid.
[192] J.M. DaCosta "On Irritable Heart; A Clinical Study of a Form of Functional Cardiac Disorder and its Consequences." *American Journal of the Medical Sciences* (CXXI, Jan, 1871) p. 21
[193] Idid. P. 21

an occasional systolic blowing sound heard over the left ventricle had ceased to be perceptible."[194]

In demonstrating that irritable heart could develop into an enlarged heart and that functional heart disease could become organic heart disease, DaCosta made one of the most important contributions to the developing specialty. It was very significant that he published the diagnostic signs by which to differentiate between functional and organic heart disease. He posed a number of questions and illustrated his findings with Civil War case studies. In discussing the diagnoses of valvular disease and the "landmark of affections of the valve—a murmur" he demonstrated with "a series of observations commenced seven years ago" the real "value and meaning of cardiac murmurs."[195]He demonstrated through his investigations that a patient with an apical systolic murmur could develop/or that it could be caused by "significant mitral regurgitation."[196]In determining these phenomena he examined the "general character of heart murmur and attending phenomena" as signs of valvular disease, but he established this over seven years and with repeated examinations of his Civil War patients (which was very important since heart disease develops slowly.)[197]He studied in detail, the murmurs: aortic murmurs, constriction by surrounding altered pericardial or pulmonary structure, at or near the apex beat, from organic mitral regurgitation (or the absence of the murmur here), localization of the murmur (above the apex over the body of the left ventricle); he judged the harshness or softness of murmurs and the inconstancy of the murmurs were described and illustrated with case histories. He then examined the "phenomena with which the physical signs are associated" and he suggested that "they occur in persons who present palpitation and more or less shortness of breath as symptoms, but not that violent dysponea which we encounter in some organic valvular affections; nor is dropsy a

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[194] Ibid. p. 22
[195] Ibid.
[196] He understood that enlarged heart was the result of mitral valve function and dysfunction, or inflammation of the valve, or thickening and hardening of the heart muscle but he did not know the underlying causes of mitral regurgitation. We know today it is caused by degenerative disease (valve prolapse) or due to the consequences of coronary disease—both are treated by sophisticated operations involving valve repair or valve replacement. DaCosta spent much of his investigations trying to understand the symptoms and the role of different murmurs in leading to valvular disease. The important point is the change in his thinking as a result of his observations; namely, that functional heart disease could develop into organic heart disease and vice versa.
[197] J.M. DaCosta "On Irritable Heart; A Clinical Study of a Form of Functional Cardiac Disorder and its Consequences." *American Journal of the Medical Sciences* (CXXI, Jan, 1871 p. 18.

concomitant."[198] He also found that anemia was a complication of heart disease rather than its cause, and that persons could look healthy; thus the focus had to be on the action of the heart, specifically the "action of the murmurs." In delineating the differences and transition from functional to organic heart disease he concluded, "the inconstant murmurs of the examination of which has occupied so large a share of this inquiry, and in which I encountered after the lapse of time, obvious valvular disease existed."[199] Importantly, he established information that could help other physicians understand what different murmurs (or the presence or absence of murmurs meant) when developing a diagnosis. More significantly, he cautioned physicians not to ignore functional disorder of the heart or assume it could go away for if left untreated it could very well pass into an "incurable malady."[200] He was able to determine these results because of his on-going association with his patients. Moreover he elucidated the importance of accurate patient histories, record keeping and long-term studies for producing new forms of medical knowledge. Having Civil War patients as an on-going resource was very important in the development of clinical specialism by giving the original research added dimension (in this case showing the progression from functional to organic heart disease), but it also allowed DaCosta the opportunity that most physicians around the world did not have: research subjects in which the disease and its long-term manifestations could be continually studied.

Pathological Specialism at the Army Medical Museum:

Physicians used the war experience to carve out professional categories by developing new ways to understand medicine and disease. Though not strictly a specialism by today's standards,[201] some physicians did develop their knowledge in

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[198] J.M DaCosta "On Functional Valvular Disorders of the Heart" *The American Journal of the Medical Sciences*, CXV (July, 1869) p. 23.
[199] Ibid. p. 34.
[200] Ibid. p. 34.
[201] Historians have been very deterministic in their analyses of the emergence of medical specialties. The second half of the 19th century was very open and individualistic in the way research was pursued. What might be termed specialized research today was for some, specialization, particularly in the absence of more structured research programs. Many physicians in the 19th century were members of *numerous* societies (specialty and otherwise). Woodward saw himself as a specialist in the fields of microscopy and photomicrography, and he developed these tools in his basic tissue research at the AMM. We cannot get a sense of how specialty study develops in the 19th century if historians impose restrictions on what constitutes a specialty (before the categories themselves are fully formed). Woodward's efforts to develop specialized study represents a specific cast of mind—much like that of Keen, Mitchell or DaCosta. Further, there was a strong sense in the mid to late 19th century that microscopic expertise could transform medicine—once microscopy was effectively mastered. As "evidence of increasing specialization within medical science" Rudolph Albert von Kolliker gave up "his joint chair in physiology and comparative anatomy in 1864 to concentrate his energy

collateral sciences, the most significant of which was the use of photomicrography to illustrate and study disease processes and the pioneering use of aniline in histological research. This work was significant both for the results obtained by the experimental research and the methodology and increased reliance on investigative medicine as a means in which to understand disease more fully. It also illustrates the dynamism of the war years and the new environment physicians had in which to carve out new fields of investigation and intervention. There were a variety of factors which supported the development of pathology and microscopy: Circular No. 2 demanded the study of specimens, which extended to basic tissue research and thus the development of organic localism was important for the emergence of this specialty. However, the institutional support provided for by the new museum, the access to new technologies, the demand for educating physicians in the field about camp diseases, along with Joseph Woodward's sheer desire to develop his microscopic expertise, all played a role in the development of pathological specialism.

Woodward had long been interested in microscopy, and his school notebooks show numerous notes and experiments on the use of heat, electricity, light (chemical changes that the sun can produce), the atmosphere, oxygen, hydrogen, carbon and nitrogen including ideas about how each could be variously used in microscopial experiments.[202]To manage disease better during the war, Woodward advocated the more widespread use of the microscope for anatomical investigation and practical work supporting the emerging relationship between science and practice and this was important for the development of scientific medicine. As curator of the medical section of the Army Medical Museum the skills he developed in relation to his investigations reinforced a specific set of criteria by which to investigate disease processes. During Woodward's tenure at the museum he was able to develop investigative tools for the study of medicine, which consisted of analyzing and comparing disease processes through photomicrography (photography through a compound microscope) particularly its uses for obtaining accurate representations of pathological histology. He engaged in a number

on microscopial work" believing his findings would transform medicine. See, Bynum, pp. 100-101. Woodward similarly suggested that mastery of microscopy, photo-micrography and histology would lead to better diagnosis and treatment for Civil War soldiers.

[202] Personal Papers of Joseph Woodward, OHA RG 363,(NMHM)

of experiments with photomicrography and was among the first in America to apply its uses to pathology. Part of this interest was stimulated by Circular No. 5, which provided for the publication of the *Medical and Surgical History of the Rebellion,* and he wanted to illustrate the work at the museum and the medical cases under investigation with photomicrographs to explain and illustrate the manifestations of the various camp diseases.

Like Mitchell, Keen, Morehouse and Da Costa, the results of Woodward's first experiments, published in 1865 in the *American Journal of the Medical Sciences,* brought him international acclaim. In America up to this time the examination of tissue sections had always been limited to unstained material, although vegetable and animal dyes were being used in Europe. The preparation of dyes from aniline began in 1856 and Woodward appears to have been one of the first Americans to have stained thin sections of tissue with aniline dyes, using this method as early as July 1864: "I have made considerable use of aniline in my histological studies, and they have been extensively employed in the investigations carried on under my direction for the microscopial department of the Army Medical Museum."[203]Through experimentation, he popularized the use of synthetic red and yellow aniline dyes, using the colors to make certain parts of the tissues more visible, which he observed, "appears to be unknown in this country, and so far as I can learn from the journals accessible to me, is imperfectly understood abroad."[204] Like Mitchell, Keen and Da Costa, he published detailed accounts of experiments, which in many ways became a guide for physicians not previously acquainted with microscopic research. Like other emerging specialists, he found an identity in these investigations:

> The earliest detailed investigations into the pathological histology of the intestine in the camp fevers and diarrhoeas of our armies during the present war were made by me, at the Surgeon General's Office, in the fall of 1862, and a brief sketch of the chief points which I had up to that time established were published a year subsequently in my book on Camp Diseases. These are the only observations of the subject which have hitherto been published, and so far as I have been able to learn they are the only ones which have been made, with the exception of the careful studies which have recently been carried on under my supervision in the microscopial branch of the Army Medical Museum, by Assistant Surgeon E. Curtis.[205]

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[203] Joseph Woodward, "On the use of Aniline in Histological Researches; with a Method of Investigating the Histology of the Human Intestine, and Remarks on some of the Points to be Observed in the Study of the Diseased Intestine in Camp Fevers and Diarrhoeas" *American Journal of the Medical Sciences* Vol. (XCVII) Jan. 1865: 106-113.
[204] Ibid. p. 107.
[205] Ibid. p. 109.

Woodward and Curtis engaged in a "number of experiments" to determine the most efficacious method for photographing histological specimens. These generally included staining certain tissues with different color aniline to see what photographed best, along with experimenting with different sizes of soft tissues (thickness), he and Curtis cutting the sections of tissue themselves with a razor or dissecting knife.[206]Some of Woodward's most significant work related to the investigation of the minute conditions of the mucous membrane of the intestine due to the "fever and diarrhea prevalent in the army."[207]He asked doctors in the field to preserve specimens from soldiers who had suffered from chronic diarrhea; they should "consist of as much of the intestine as is diseased even if the disease involves the whole. It should be taken out in one piece, the small intestine carefully preserved."[208]The two developed a specific methodology for investigating the pathology of intestinal disorders.[209]Specimens would be procured from soldiers at autopsy, a piece of intestine was selected, boiled with dilute nitric acid in a porcelain capsule for two to five minutes, "pinned out loosely on a flat cork to dry" then every trace of fat was removed.[210]Woodward recommended taking a very thin piece of the intestine and using an ethereal solution of red or blue aniline for permanent preparations, soaking them for 24 hours, transferring them to turpentine and concluding by mounting them in Canada balsam; these were ideal for study with a lower powered objective. The permanency of this preparation made it ideal for examining structural changes including enlargement of the solitary follicles and ulceration.[211]He gave the structures different tints in order to examine each separately in the hopes of

[206] Woodward's Letterbooks, Otis Historical Archives RG 28 (NMHM) Letter to Dr. Sam Jones, Microscopial Society Dec. 12, 1865 from Woodward.. This letter outlines the types of experiments they were performing at the museum. Notes that he found yellow the best because a very short exposure does the work.
[207] Woodward's Letterbook, Otis Historical Archives RG 28 (NMHM)Letter from Woodward to Virchow, Feb. 1864
[208] Woodward's Letterbook Otis Historical Archives RG 28 (NMHM) Letter from Woodward to H.E Brown, Nov. 26 1865.
[209] It is significant that in this article he devotes two paragraphs on his earlier method, which he found less effective (which involved cutting sections of intestines, soaked, and dried). He found after drying they changed shape, that it was difficult to cut good sections without the follicles chipping off and that the sections often became disfigured by the oil-drops. This again could be effective for new researchers or less experienced physicians to use as a guide.
[210] Ibid. p. 110.
[211] Joseph Woodward, "On the use of Aniline in Histological Researches; with a Method of Investigating the Histology of the Human Intestine, and Remarks on some of the Points to be Observed in the Study of the Diseased Intestine in Camp Fevers and Diarrhoeas" *American Journal of the Medical Sciences* Vol. (XCVII) Jan. 1865. p. 110.

understanding better the disease process.[212] For studying preparations with the highest powers of the microscope, he advised cutting the sections as thin as possible, soaking them in a "feeble solution of red, yellow, blue or purple aniline in a dilute acetic acid" for 24-48 hours, with the objective being to illustrate the presence of "flask shaped ulceration present in the mucosa," which he incorrectly believed was the enlargement and multiplication of cartilage cells.[213] Sections were then mounted in liquor or glycerine, preserved and covered with a thin glass cover.

It is very significant, in accounting for the emergence of medical specialization in the nineteenth century, that the primary focus of Curtis and Woodward's first article was to outline their methodology with such precise detail, and perhaps more importantly their objective was to "invite other laborers to enter the field."[214] This means of investigation began to be utilized more frequently. For example, in the spring of 1864 and 1865, Assistant Surgeons Norris and Thompson at Douglas Hospital took microscopic photographs of sections of femur, eyelid, kidney, ileum, colon and skin to demonstrate the value of photomicrography in investigating disease processes and its possibility with the compound microscope then issued by the Surgeon General's Office to the general hospitals.[215] They used enlargements from 15-250 diameters, the negatives being made with the various objectives alone with eyepieces aided by an ordinary camera using the wet collodion process.[216] Of particular interest were the photomicrographs of the perpendicular section of ileum showing enlarged solitary follicles, perpendicular section of the human kidney and transverse section of bone x 50 diameters, which were displayed at the International Exposition in Philadelphia in 1876.[217] The results of these experiments were later published in the museum catalogue and Woodward observed:

These photographs are very satisfactory as representations of the views given by moderate magnifying powers. The extent of the applicability of the process to the high

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[212] Being able to use different colors for different sections provided the contrast Woodward wanted when studying tissues.
[213] Joseph Woodward, *Outlines of Chief Camp Disease*, Section IV. He likely saw inflammatory bowel disease
[214] Ibid. p. 113.
[215] Woodward's letterbook, Otis Historical Archives RG 28 (NMHM), 1864 "Memorandum."
[216] Thompson Photomicrographs, Otis Historical Archives RG 330 (NMHM).
[217] Ibid.

powers has yet to be determined. Experiments are about to be undertaken on this subject in the department of the museum under my direction.[218]

The results of the wartime photomicrographic investigations were used in many postwar publications including a volume of microphotographs for display at the Paris Exposition,[219] the *Medical and Surgical History* and *Circular No. 6* where Woodward observed that it was his intention to educate physicians by elucidating the developments that resulted during the war through the use of photomicrography to illustrate disease processes. While his publications generally illustrate his methodology on photomicrographic technique, the manuscript sources illustrate how he was able to develop this relatively new specialty. Photomicrography, in which a camera becomes an essential part of the microscope,[220]was a tool used for basic tissue research and Woodward's interest in its application fit well into the overall function or ideology of the medical museum. During the war microphotography was primarily a means by which to *display* and *document* the results of microscopic analyses. It was commensurate with how Civil War physicians produced knowledge: through the empirical observation of thousands of facts, cases and observations, with photomicrography once again providing another means to see the body. The direct result of the many deaths and diseases that dominated during the war became the subject for experimentation. Medical specimens with lesions were prominently displayed at the museum along with such surgical specimens as arms, legs, craniums, feet, hands both to showcase and to understand the effect of diseases and wounds on the body. The work was part of the larger desire to develop medical knowledge and treatment. With the use of microphotographs, physicians could now see microscopic material, the result of the tissue research that was being

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218 Joseph Woodward, "On the use of Aniline in Histological Researches; with a Method of Investigating the Histology of the Human Intestine, and Remarks on some of the Points to be Observed in the Study of the Diseased Intestine in Camp Fevers and Diarrhoeas" *American Journal of the Medical Sciences* Vol. (XCVII) Jan. 1865 p. 113

219 Woodward's Letterbook, August 23, 1866 Otis Historical Archives RG 28 (NMHM) Letter to J.C. Derby, in which he notes that the microphotographs should be "displayed on a table, under glass, a space of 10 feet long by 4 inches wide." See also, OHA RG 76 (NMHM) "International Exposition of 1876, Medical Department"; OHA RG 12 (NMHM) Curatorial Records, Expositions.

220 Woodward and Curtis created a photomicroscopic apparatus and first used sunlight as the source of illumination which was reflected by a heliostat. The light passed through a copper ammonio-sulfate solution light filter before passing through the specimen. The image was projected through the microscope, the eyepiece now a concave lens, onto a movable plate holder. He later pioneered the use of artificial light sources (magnesium and electric lights). See Amy Rapkiewicz, Alan Hawk, Adrienne Noe, David Berman, "Surgical Pathology in the Era of the Civil War: The Remarkable Life and Accomplishments of Joseph Janvier Woodward. (*Arch Path Lab Med*) Vol. 129, Oct. 2005: 1313-1315.

performed at the museum. Once again the recognition of this methodology, which established new epistemological standards for the physician/researcher, did much to garner support and interest in photomicrography.

But how did Woodward develop this expertise? One of the ways in which he developed this specialty was through his communication with the eminent physician, Dr. Robin Leach Maddox, who pioneered the use of photomicrography in London and had won awards for his microphotographs in 1853 from the Photographic Society of London.[221] The international transmission of knowledge was a key theme in these investigations. Woodward wrote numerous letters to Maddox, which contain questions for help in perfecting his technique (particularly regarding photography), and Woodward was very pleased when Maddox validated the work being done at the museum:

> I have had a private letter from Dr. Maddox in which he acknowledges the army medical museum microphotographs to be the best made anywhere. You will see by the enclosed extract from the British Journal of Photography that Dr. Maddox and others do not hesitate to state this publicly.[222]

Woodward and Maddox exchanged letters on methodologies and many photomicrographs to illustrate their preparations.[223]At the Medical Museum, Woodward directed experiments to develop his expertise and knowledge of microscopy and photomicrography, which consisted first of developing the basic apparatus. He wrote to M. Zentmeyer, an eminent microscopist[224] in 1864:

> I wish you to make for the army medical museum an apparatus for photographing microscopial preparations. It must consist of a heavy base board of black walnut, at the end of which is to be an arrangement for clamping fast the microscope of your make which is in use here (it is no. 36) at the other end a platform on which a four by four photographic camera box can slide. This box must have a draw of eight inches; its front is to be made to receive the eye piece end of the microscope with or without the eyepiece by a joint which will exclude light. The whole to be made of black walnut oiled. The following points require care: The center of the ground glass of the camera to be centered with the microscope. The camera to slide back and forth without lateral motion and so that it can be clamped in the position required, the ground glass meanwhile being always

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221 Maddox is best known for producing the first workable dry plates using gelatin as the medium to hold the silver bromide.

222 Woodward's Letterbooks, Otis Historical Archives RG 28 (NMHM) Letter to M. Wales from Woodward, June 25, 1866.

223 Ibid. Letter from Woodward to Maddox thanking him for the photomicrographs he presented to the museum. November 10, 1866.

224 And a constructor of microscopes.

perpendicular to the axis of the microscope—I enclose a drawing of what I mean based on some experiments made here which promise satisfactory results.[225]

As test objects to check the quality of the lenses, he used the standard diatoms (pleurosigma angulatum, podura plumbia), a few parasites including acarus scabe, trichina spiralus and demodex folliculorum; a few anatomical objects including muscle, bone and nerve-cells, and lastly, a series of preparations illustrating the pathological anatomy of the intestinal ulcers of camp dysentery and of the ulceration of the intestine in camp fever and a series on the small pox pustule.[226]He photographed the preparations from nature and painted them on glass and the pathological specimens were printed in their natural color. He used the glass points as lantern slides (oxy-hydro calcium stereaptieon) on a screen of 12 feet square and experimented with powers ranging from 1000-760,000 diameters.[227] Most of the experiments Woodward undertook with Curtis related to the range of magnification and optical setup for the purpose of establishing the best means to "amplify with much distinctiveness." They experimented with the 1/8th, 1/50th, 1/16th, 1/4th, 1/25th and conducted trials with the "most difficult diatoms" to achieve the best results.[228]The goal was to improve the method of "dealing with soft tissues of the higher animals" which could be done through optimal magnifying powers.[229]Once the quality of the photographs was established, they elucidated their findings and compared and debated the results. For example, Maddox found in experiments with a series of prints of the tumbler and of angulation that a "luminous focus of light is formed in front of each protuberance; this false object or image forming the white ball in the picture, which is elevated above the apparent black opening."[230]Of this finding Woodward observed to Maddox that it was a "disturber of some of his notions."[231]The root of the difference was whether the markings on the angulations were round, hexagonal or disc shaped, holes or a circular depression. Faithful representations

[225] Woodward's Letterbooks, Otis Historical Archives RG 28 (NMHM) to M. Zentmeyer, Nov. 11, 1864.
[226] Woodward's Letterbooks, Otis Historical Archives RG 28 (NMHM) Letter to New York Microscopial Society, May 20, 1868 regarding his work at the museum during and after the war.
[227] Ibid.
[228] Diatom resolution test included looking at Pleurosigma angulatum or Frustulia rhomboids to check the quality of their lenses and microscope expertise.
[229] Letter from Woodward to John LeConte May 25, 1866. (APS) BL 493 LeConte Papers August 1864-June 1866.
[230] Woodward's Letterbooks Otis Historical Archives RG 28 (NMHM). Letter from Woodward to R.L. Maddox March 25, 1867.
[231] Ibid.

through photomicrographs, and especially "seeing correctly," were of crucial importance to Woodward. It was so important to him because it confirmed the quality of the lenses and also spoke to the efficacy of his microscopic expertise. He tested every lens thoroughly, hoping to establish a foundation for the development of this research tool:

> The lenses have at length after many custom house delays all arrived. The 1/20th of Powell and Lealand is a glass I can work with readily and I like the 1/16th even more. I never liked the 1/50th though I believe my photographs with it show that I can manipulate it up to its capabilities. The 1/25th and 1/16th however, I must regard as splendid glasses and as valuable additions to our collection of lenses. The 1/8th and 1/4th of Ross are not so good as I expected from this celebrated house, certainly his 1/8th does not compare with Wales', still they are good lenses and I am glad to have them. The 2/3 of Smith and Beck is a splendid glass for that power. Wales has just made me a 1/15th inch which is a very good glass and I hope before long to make a comparison.[232]

Woodward and Maddox both experimented with the construction of a 1/16th for photographic purposes but neither had much luck initially and they frequently commented on their experiments and why they may have failed. They also shared their methods on taking measurements of the photographic image:

> After taking a photograph or a series or photographs with any given power, its object is removed from the stage and a stage micrometer substituted. The image of this micrometer we have sometimes photographed, but generally resort to the simple plan of receiving the image of the micrometer on a piece of ground glass from which the size of the magnifying divisions of the micrometer can readily be taken off. Of course it gives the elements for determining the size of the object photographed and the magnifying power employed with accuracy which is only limited by the accuracy of the stage micrometer.[233]

To show his gratitude for Woodward and Curtis's time, Maddox presented the museum with a "beautiful set of photomicrographs," which he had specially bound.

The transfer of knowledge was crucial both for the development of this branch of science but also for American medicine. A.M. Edwards, President of the American Microscopial Society, wrote Woodward asking him to share his findings and methodology concerning the microscopic and microphotographic work being performed at the museum. Woodward was very pleased and responded that it would be his "pleasure to communicate with you on any subject concerning microscopy or microphotography";

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232 Woodward's Letterbooks Otis Historical Archives RG 28 (NMHM). Letter from Woodward to R.L. Maddox June 17, 1867.

233 Woodward's Letterbooks Otis Historical Archives RG 28 (NMHM). Letter from Woodward to R.L. Maddox November 10, 1866.

he also sent a copy of Circular No. 6 for members of the society along with an open invitation to the museum's laboratory.[234]Edwards presented Woodward with a number of specimens, which Woodward and Curtis photographed and presented to the American Microscopial Society. Woodward was elected an honorary member for his "work and advances in the areas of normal and pathological histology."[235]He maintained his association with the society and though he adopted the position of "expert" relating to the development of this work it was a highly collegial relationship. As Woodward remarked:

> I sent by today's mail two packages: one containing a dozen microscopial preparations, chiefly of the soft tissues mounted in Canada balsam preserving most of the structural appearances which could be seen in glycerine preparations. Also a package of photomicrographs of podura. I want to ask you to exhibit these preparations and photographs to the microscopial society and to any others in New York who are interested in such things. I should also be happy to hear the criticism of any points that may occur to you.[236]

The museum's incoming correspondence illustrates the widespread dynamism of this period in medicine. Woodward, for example, wrote Heinrich Frey of Zurich, Switzerland in response to Frey's recently published "Das Microscope":

> I take the liberty of sending you by permission of the Surgeon General photographs based on your work in which you may be interested. I send you a photo of the pleurosigma angulatum prepared with an English 1/50 objective, no eye piece was used and distance was about three feet. The direct picture was about 2500 diameter linear. With this objective which is quite manageable, 5000 diameter can be obtained whether for vision or photography by proper eye pieces for the first and proper distance for the latter, but definition diminishes if 2500 diameter is exceeded. The second picture is an enlargement from the first to 19050 diameters. The third is about the same power as the first, taken with an American 1/8th the necessary power being given to a concave lens introduced into the body of the microscope. You will see the great magnifying power has been matched and will show also something of the quality of these glasses. I will take the pleasure in answering any further questions that you may desire to ask about them.[237]

Woodward also corresponded with physician T. Murmich of Vienna and had a vigorous intellectual discourse with him about the development of microphotography:

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[234] Woodward's Letterbooks Otis Historical Archives RG 28 (NMHM). Letter from Woodward to A.M. Edwards, Feb. 15, 1866.
[235] Woodward's Letterbooks Otis Historical Archives RG 28 (NMHM) Letter from Rufus King Brown May 28, 1866.
[236] Woodward's Letterbooks Otis Historical Archives RG 28 (NMHM).Letter from Woodward to A.M. Edwards Dec. 18, 1867.
[237] Woodward's Letterbooks Otis Historical Archives RG 28 (NMHM). Letter from Woodward to Heinrich Frey August 31, 1866.

I have to thank you for your interesting letter with preparations from Gerlach. The photographs in color were a novelty to us. We have tried Gerlach's process and succeeded in it. We have also been experimenting with transferring preparations through absolute alcohol to Canada balsam as in the preparations sent to us by Gerlach. In this also we are meeting with reasonable success. I hope sometime soon to be able to send you a package with samples of our summer's work both photographic and microscopic, which may indicate some progress. I enclose herewith a letter for Gerlach thanking him for his kindness in sending those specimens of microscopial matters. I enclose a photograph of cartilage to show our prospect of success in the photography of the soft tissues with high powers.[238]

It is very significant that he was becoming familiar with the methodology of Joseph von Gerlach, one of the first medical researchers to use photomicrography in basic tissue research, who had only published a handbook on his technique in 1863. While Woodward was sometimes challenged by the experts abroad, he used his position at the museum to correspond with them, became one of the leading microscopists in America and laid the foundation for this science to develop.

More junior American physicians often consulted him for advice, which well illustrates the hierarchy of knowledge that supported the development of specialization. W.W. Keen often wrote to Woodward asking for microphotographic preparations to illustrate his lectures. Woodward typically replied:

I will endeavor to send you a few micro-photographs so soon as we print again which will be in a few weeks. Pardon me for saying here in the interests of the medical profession, if you are going to teach the microscope the sooner you learn to make your own preparations the better. No one is an accomplished microscopist who cannot make his own preparations. Extemporaneous preparations for each lecture are rapidly prepared by Beales method and the best of these put away in balsam by Gerlach's method from year to year, will soon lay the foundation of a good cabinet. Of course this implies labor, but no more than every European teacher.[239]

Woodward was never mean spirited about advice but recognized that medical practice during (and as a result of the war) occupied a new intellectual space: Americans were now producers of medical knowledge. As curator of the medical section of the museum he aptly filled the role of educator:

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[238] Woodward's Letterbooks Otis Historical Archives RG 28 (NMHM) Letter from Woodward to T. Murmich June 26, 1866.

[239] Woodward's Letterbooks Otis Historical Archives RG 28 (NMHM). Letter from Woodward to Keen, March 25, 1867.

The Beales method in all details see his "How to work with a microscope' last edition—Gerlach's method you will find in Frey's book 'Das Microskope.' It consists simply of putting the section already injected and stained into dilute alcohol, transferring hence to stronger and stronger alcohol from day to day finally to absolute alcohol, thence to turpentine and then mounting in cold balsam rendered fluid by chloroform. I have sent some of our pathological microphotographs printed for you.[240]

The Army Medical Museum was an important institutional foundation for the development of medical specialization. Before medical school curricula were changed,[241] and while associations and journals were in their early stages, the museum provided intellectual support for some emerging specialties and scientific medicine. Many physicians wrote the staff for advice about unfamiliar branches of medicine:

For the last year I have been deeply interested in microscopy and am a hard working student. The particular branch I am devoted is the study of diatomaceal and involving the use of chemicals and the surrounding of the laboratory. I find myself in my cramped quarters almost wholly unable to carry out so far as the preparation of the crude material for examination is concerned. Knowing that the museum has a fine microscopic department of which Dr. Woodward is one of the most, if not the most eminent microscopists of this country, it occurred to me through you I might be able to obtain from their supply some of some of the Diatomaceous material already prepared for mounting, which portion of the process I am fully prepared to carry on and am doing very successfully.[242]

Even the most eminent physicians profited from the museum's resources. The physician William Osler often took advantage of the resources at the museum. His numerous letters to the staff contain requests for access to specific specimens and he sometimes visited to examine, photograph and make drawings which were used to illustrate his own work.[243]

Woodward believed in the efficacy of scientific microphotography and displayed and documented the results of the microscopic analysis being conducted at the museum. He studied the original preparations and the microphotographic preparations but he was

[240] Woodward's Letterbooks Otis Historical Archives RG 28 (NMHM). Letter from Woodward to Keen, June 21, 1867. It was clearly a goal of Woodward that American medicine be oriented along the same lines as top European teaching and research institutions.
[241] Toward the end of the century, medical schools began reforming their curriculums by adding courses (e.g. clinical medicine, microscopy, anatomy, physiology, comparative osteology, pathological anatomy, surgery etc.), which had been traditionally covered in private courses. Faculties were also expanded to meet the new needs of the schools. For more on medical education in the later 19th century see, Ronald Numbers (ed.) *The Education of American Physicians.* (Berkeley and Los Angeles, University of California Press, 1979). See also Rothstein, *American Medical Schools.*
[242] Incoming Correspondence, OHA RG 13 (NMHM). Letter to Surgeon General Robert Murray from R.P.K Durkee, May 9, 1884.
[243] Incoming Correspondence, OHA RG 13 (NMHM). William Olser often wrote John Shaw Billings and asked to see and draw specific specimens. See letters to Billings 1886-88.

most interested in the methodology and "theoretical considerations" involved in developing this new means of understanding and displaying the results of diseases. Microscopic preparation allowed him to examine different stages of the disease process along with the alteration it produced. Allowing physicians to see the microscopic material of the various diseases supported the development of scientific medicine by Woodward's standards, which still focused on documenting the results of microscopic analysis for viewers to judge themselves. He emphasized both anatomical change and with the benefit of the case histories that accompanied specimens also thought in terms of physiological function, using the microscope to make the finest distinctions between tissue changes that he could. This was a central goal as Woodward noted: "the preparation of proper sections, with which only intelligent microscopial researches with tissue metamorphosis can be made, is understood by but few physicians in America and practiced by still fewer."[244]The microscopial series was initially begun because "no intelligent efforts to prevent disease can be made without a reasonable comprehension of their nature, and this must rest a basis upon a just knowledge of pathological anatomy."[245]In just three years, as Woodward observed, "the result of this effort is the microscopial series, which although small indeed when contrasted with some of the better European collections, is the only considerable micro-pathological collection in the United States." [246]With the high number of specimens representing specific diseases, Woodward could examine the various stages of disease, providing insight into how they seemed to function within the body which led to new paradigms of disease. He established new epistemological and technical standards and constantly corresponded with leaders in the field. He built his own reputation but also the reputation of American physicians at the Army Medical Museum who became known around the globe for their expertise in studying and managing the range of camp diseases encountered during the war. His work was important in the development of scientific medicine in America because he showed the efficacy of medical research along with clinical medicine for understanding and managing disease processes. Significantly, he discussed this work in the context of scientific medicine, which he framed as the way to approach the study and practice of medicine. This differentiated the work at the museum

[244] RG 112 (NARA) Rough Draft of Circular No. 6 p. 156.
[245] RG 112 (NARA) Rough Draft of Circular No. 6 p. 156.
[246] Ibid.

from both traditional approaches to the study of disease and also from the rank and file physicians, laying the foundation for medical specialization.

Putting a New Face on War: Reconstructive Surgery and the American Civil War

Challenging cases, the growth of hospitals, the need to manage the soldiers after battle, the opportunity to develop specific expertise and the wealth of clinical material all had a tremendous effect on the development of surgery. As illustrated in the previous chapter, some Civil War physicians made tremendous strides in preventative medicine, including controlling infection, managing infectious disease environments and disseminating the knowledge ascertained so that many physicians became aware of how best to treat patients and control the spread of these diseases with antiseptics, particularly after surgery. Not only did the hospitals provide ample clinical material, some cases demanded specialized care which created an environment in which to develop specific surgical skills. One of the most interesting new areas was reconstructive surgeries, largely pioneered by Dr. Gurdon Buck.[247]The unification of medicine with surgery was important here. General practitioners were agreed on a common goal during the war: to understand the range of diseases so that the troops could be effectively treated. Some directives, such as Circular No. 2 or circulars demanding essays and the results of experiments relating to specific diseases, helped physicians to see themselves as part of a professional network. These directives also encouraged and created shared training and research experiences; and as medicine overall became more united, it became natural to branch out into specific areas of medicine, now with greater support from the profession.

In considering the development of reconstructive surgery, it is clear that some physicians used the medical opportunity of the war to develop their expertise. But reconstructive surgery also had a very practical function: to make men whole again, putting them back together so that they could function effectively in postwar America. The case reports reveal that a central objective of "plastic operations" was to repair facial wounds of the soldiers so that they could return to their pre-war lives. While the loss of

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[247] Not strictly a reconstructive specialist, Buck also invented a device for treating fractures of the femur known as "Bucks Extension" a splint used as a surgical aid in the treatment of fractures. It was a modification of "Physick's Desault" in which the splint was dispensed with and constant and uninterrupted extension was kept up by means of weight and pulley. See, *The Medical and Surgical History of the War*, Part III, Volume II p. 348. He also sat on the Council of Hygiene and Public Health to give recommendations on how to reform the unsanitary conditions in New York. See, George Rosen, *A History of Public Health* (Johns Hopkins University Press, Baltimore, 1993): pp. 220-221.

limbs was associated with heroism and a physical representation of their sacrifice to the war effort, facial deformities were more difficult to accept. Surgeons were aware of this contradiction. Case reports often comment on the "improved appearance of the patient" upon successful reconstruction and "saving" these men from potential ostracism, in part as well guided the desire to develop this area of expertise. As Gurdon Buck's son recalled:

> ...In one of these cases the greater part of the nose, upper lip and adjacent cheek had been destroyed, and the poor fellow presented such a repulsive spectacle that everyone shunned him. For a period of about two years, as nearly as I can recollect, father persevered in his efforts to reconstruct the missing parts. Operation followed operation at intervals of 2-3 months...finally, all his efforts were crowned with success, the man had a new nose, full upper lip, and an entire cheek. At the time he was dismissed to his home his face presented a very lumpy and uneven appearance; in fact, he was anything but attractive looking. But in the course of the next 2-3 years, all these grosser irregularities disappeared, and it could then be seen how marvelously well Father had succeeded in solving the difficult problem presented to him. In the meantime, the man had married and was leading a happy and useful life as a farmer.[248]

If the patient could not be made to look "acceptable," the reports would often note that the man would have to live in seclusion and would perhaps be unable to make a living. Success then was often associated with improving appearance through surgery. It was the patients who sometimes urged surgeons to "fix" their appearances: "...distressing deformities produced from excessive loss of tissue about the soft parts of the face, prompted surgeons to yield to the solicitations of the patients, and to intervene with but slight anticipation or hope of success."[249]But patients were very willing to take their chances with these experimental operations in the hope that their pre-war identities could be re-established to some extent. There were practical reasons for performing these surgeries but some physicians also welcomed the opportunity to develop specialized skills. Although many continued to function as general practitioners, their work and publications relating to "plastic operations" laid an important foundation for the development of this specialty. Like neurology, heart disease and the investigations at the museum, reconstructive surgery as a specialty followed the same pattern: specialty wards within the hospitals, the desire of the individual physician to develop this specialty, casts

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[248] Quoted in Herbert Conway and Richard B. Stark, *Plastic Surgery at the New York Hospital One Hundred Years Ago* (New York: Paul Hoeber Inc.,1953) p. 48.
[249] *Medical and Surgical History* Vol. II, Part I p. 379.

and photos sent to the Army Medical Museum allowing their work to become visible to the rank and file and publications which outlined clear methodologies to the Surgeon General. The war allowed, even demanded the rapid accumulation of this specialized knowledge.

There were a total of thirty-two "plastic operations" performed during the Civil War, which were later recorded in the *Medical and Surgical History of the War.*[250] Circular No. 2 asked that doctors submit specimens and reports of cases that were deemed "interesting" or "important" and reconstructive surgery fell well into these categories. A number of physicians performed reconstructive surgeries during the war and published their findings.[251]Dr. Howard Culbertson, surgeon in charge of the Harvey General Hospital, for example, engaged in a number of experimental surgeries in 1864 and 1865. Of particular interest to him was the case of Archibald Pringh, Private Co. C 16th Wisconsin Infantry who suffered a gunshot flesh wound to the side of his face. The minie ball had passed over the left malar bone, divided the soft parts of the face in its course, separating the lower lid of the left eye of its inner angle, divided the cartilage close to the nose and passing out the right cartilage.[252]Culbertson would perform three operations on Pringh, and illustrated his case report with detailed drawings of each stage of the three. The first operation was performed on October 19, 1864 when he attempted to reconstruct the face. Culbertson reported in detail each stage of the operation in which flaps of skin were used to replace facial sutures. After cutting away the scar tissue, the patient was placed "fully under the influence of chloroform,[253]nostrils plugged and an incision was then made along the inner margin of the destroyed lower eyelid and carried downward a quarter of inch below the lower border of the orbit and directly outward over the middle of the left malar bone and carried upward three quarters of an inch from the external orbital angle."[254]He then brought the lower lid to its natural position, without stretching it, and then made another incision over the left malar bone upon the lower edge

[250] *Medical and Surgical History of the War* Vol. II, Part I pp. 368-381. There were six cases of reparative surgery made to the eyelids, five for the nose, three for the cheek, twelve on the lips, palate or mouth, the chin in four cases and one instance of blepharoplasty and an unsuccessful case of staphylorraphy. p. 379. There were, however, many more reconstructive surgeries and the unpublished case reports and can be found in RG 94 (NARA) File A and D.
[251] At least 21 different surgeons submitted case reports of plastic operations to the Medical and Surgical History.
[252] RG 94 (NARA) Register of Surgical Operations, Harvey USA General Hospital, 1864-1865. Volume Three, Entry 559.
[253] Please see chapter four for an analysis of chloroform during the Civil War.
[254] Ibid.

of the transverse cicatrix which extended directly to the right and down to the left superior maxillary, through the right cartilage and the dense cicatrix was removed. The skin of the left cheek "exposed a thin layer of the cellular tissue and the cheek was brought upwards and inwards. The false adhesion of the cartilage of the nose was directed up, and the lower extremity of the nose was depressed to its natural position." One other incision was then made from the beginning of the first, near the inner angle of the left orbit directly downward along the base and the side of the nose to the lower border of the left cartilage; the adhesions of the latter were then directed up and the "dense cicatrix was removed from the bony margin of the nose in the line of the last vesicle incision." Culbertson then removed the mucous membrane of the inner angle of the eye. Once this was performed, it permitted all of the left side of the face to be brought up to its natural position, which was secured by fine line sutures placed three lines apart. A pattern of leather the size and shape of the transverse gap in the nose was then cut and a curved flap (2 ½ x 3 inches) one-third larger than the pattern, after having been marked out with iodine, was raised from the right cheek, and the lower border of right side of nose was level with the bony margin of the right margin. An incision of the angular artery was carefully avoided, the flap was arrested of itself so as not to interfere with circulation and laid it in its bed, and was then secured by sutures. The margins in the mid-right cheek were then brought together with sutures and plaster drawing the cheek to secure adhesions. The left cheek was also well drawn and the left lower eye lid was pulled inwards "so as to take all stress from the sutures." He gently covered the wound with lint, but did not apply water on the dressing.

Culbertson performed the second operation "a few days later" when he once again drew the wound together with sutures and plasters. The third operation was performed to divide the pedicles (flaps of skin) and replace them as far as possible to the original beds. Finally, the pedicle on the right side of the nose was divided vertically and down, made angular and a bed made for it, and secured with two sutures and plaster. He noted prior to the first operation that "inflammation of the parts had subsided" and that the patient's general constitution was "good." It was noted in the case file that the patient was removed from the operating table to his bed, after which his hands were tied down to his sides (probably so he would not touch his sutures). He was treated with morphine and it was reported that by March 31, 1865 just five months after the operation, the flap on his face had returned to its natural color. While the patient was healing, however, he continued to suffer as "his sight was lost in his left eye" and there was "constant discharge from near the nose," causing him to labeled as having a permanent and total disability.[255]Considering the environment in which medical specialization developed, Culbertson's detail in reporting each facet of the operation is highly significant. He encouraged the other physicians engaged in reconstructive surgeries to consider certain physical benchmarks in deciding when to perform subsequent "plastic operations" on a specific case: could the patient speak and articulate, could he eat, had prior operations eased the salivary discharge?; finally, physicians were advised to closely monitor the patient for months, keeping careful case notes.[256]A significant body of work in reconstructive surgeries was developed during and after the war, and many of the case reports mirror the extensive detail of Culbertson's. These first published reports on "plastic operations" became the "model" for the new specialty.

As Culbertson performed more of these procedures, he also became more confident. Reporting from the USA hospital in Rolla, Missouri he discussed the case of Patrick Shea who had suffered a lacerated wound of the soft parts of the left side of his face.[257] There was extensive damage to the face, with the anterior wall of the maxilla "driven in and broken."[258]He prepared the patient by cutting all the soft parts from the "interval angle of the eye outward to the external angle and downwards along the side of the nose through the upper lips to the left of the median line" and then dissected all of the soft parts outwards. After removing all of the portions of bone and scar tissue, he brought the edges of wounds together, secured by needles, stitches and plasters. He successfully united the lip and lower half of the nose and he performed a plastic operation to fill the space up along side of the nose. The case report concluded that the "man is doing well."[259]

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[255] Ibid. A rating of "total disability" entitled the patient to a higher pension vs. those designated as "one-half disabled." Because of the physical deformities suffered by this class of patients, the government required physicians to rate their level of patient disability.

[256] RG 94 (NARA) Records of the Adjutant General's Office, Medical Records, Reports of Diseases and Individual Cases, 1841-93, File 'A' and bound manuscripts, 1861-65 Box 12, Entry 621. Box 13, Entry A-484 "Performing a Plastic Operation" Report from USA General Hospital Rolla, MO. H. Culbertson Surgeon, U.S.V.

[257]Ibid.

[258] Ibid.

[259] Ibid.

Some patients, however, suffered horrible disfigurements and repulsed their examiners. Private Peter Jordan, Co. E, 2d Connecticut Heavy Artillery had been wounded at Cold Harbor, Virginia by a fragment of shell, which carried away the lower incisor teeth and a large portion of the lower jaw and upper lip were destroyed.[260] At the Readville Hospital in Massachusetts, Acting Assistant Surgeon Francis C. Ropes attempted a facial reconstruction. He dissected the soft parts from the jaw and "retained them as high possible with bandages." Dressings of chloride of soda were applied to the wound and within days healthy granulations appeared; however, saliva constantly dribbled from the patient's mouth. A pension examiner reported five years later that saliva continued to drip from the patient's mouth and that the "mouth presents a shocking deformity, which in great measure, excludes him from society."[261] Similar was the case of Private Garrett Rozell, 16th New York Battery, who had been wounded in the engagement at Chapin's Farm Virginia, Sept. 29 1864 by a piece of shell, which tore away the eyebrow, eyelid, and part of the temporal and malar bones, completely extirpating the left eye and opening a wound into the nasal bone, leaving the loose appendages turned inward and hanging over the cheek as low as the middle of the nose. After being treated at the hospital at Fort Monroe, Virginia for a period of three months, he was admitted to the hospital at Elmira, New York. By then the wound had healed, but a fistula existed in the nose. On March 31st a plastic operation was performed by Assistant Surgeon A. Merrill, while the patient was under the influence of ether. The lid and brow were dissected away from the "unnatural adhesions, their old positions as far as possible resumed, the cicatrized surfaces again made raw by a removal of the skin, and seven sutures taken and adhesive straps used to retain the lid in its place."[262]After suffering an infection from erysipelas, the patient healed somewhat and was released 21 July, 1865. His case report noted that upon examination from physician John G. Orton M.D. July 27, 1867 "the face is so badly disfigured that he will ever be an object of pity and unable to gain a living, except in seclusion from society."[263]The doctors saw themselves as only partial specialists who engaged in these "plastic operations" out of

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[260] *Medical and Surgical History* Vol. II, Part I p. 370.
[261] Ibid.
[262] *Medical and Surgical History* Vol. II, Part I, p. 368.
[263] Ibid.

sheer necessity but also functioned as general surgeons. They did, however, share the desire to develop expertise in treating this class of sufferer. More significantly, they emphasized the potential of this specialty, the importance of knowledgeable physicians in performing these operations and the dissemination of this new knowledge.

Like Mitchell, DaCosta and Woodward, Gurdon Buck was very effective in the development of reconstructive surgery as a separate specialty. The minie ball caused a severity of injuries unprecedented in American medicine and Buck, a pioneer in military plastic surgery, responded to the challenge. He graduated from the College of Physicians and Surgeons in 1830 and prior to the war he studied in Paris and Vienna before being appointed visiting surgeon at the New York, St. Luke's and Presbyterian hospitals, a visiting surgeon at the New York Eye and Ear Infirmary and a founding member of the New York Pathological Society. His work was considered highly successful and provided a model for plastic operations to develop. The *Medical and Surgical History* noted, "Dr. Buck's operations must be reckoned among the chief triumphs of modern plastic surgery."[264]One of the reasons his work was so revered was that his approaches were so innovative. *The Medical and Surgical History* observed that while most surgeons followed Jobert's method,[265]Buck's "extraordinary operations abounded in original expedients." In particular, he detailed specific methods for "advancing tissue through the use of relaxation incisions," the "outline of pedicles by pattern" and the "rotation and advancement of flaps of soft tissue."[266]His medical experiences during the war profoundly affected his development as a surgeon. It was in the wartime hospitals that he developed the operative method for correcting congenital deformities, including "hare-lip, alveolar clefts, macrostomia and macrocheila." He also described for the first time the "pachydermatoceles of von Reclinghausen's disease" in which he "sectioned the body of the mandible for reconstruction of the nose," [267]and finally he developed innovative treatments to treat and manage burns.[268]

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[264] The authors' were referring to his successful facial reconstruction of a patient that suffered massive facial trauma (to be discussed below). *Medical and Surgical History* Vol. II, Part I. p. 379.
[265]Claude Bernard and Charles Huette, *Illustrated Manual of Operative Surgery and Surgical Anatomy* (New York: Bailliere Brothers, 1861) pp. 271-272.
[266] Herbert Conway and Richard B. Stark, *Plastic Surgery at the New York Hospital One Hundred Years Ago* (New York: Paul Hoeber Inc.,1953) p. 4.
[267] Ibid. p. 10.
[268] Ibid.

This was a huge service to the profession since he "contributed to the museum a number of casts and photographs illustrating the remarkable operations that he has accomplished for the repair of deformities from shot injuries of the face, with references to the instructive descriptions that he has published in the journal, of the steps of these difficult and ingenious surgical achievements."[269] Hammond recognized the value and uniqueness of these cases and ensured that they were submitted for the museum.[270] As a result, Buck's work was prominently displayed there:

> I enclose herewith the history of the case requested and it is accompanied by a photographic liking of the patient. The record of the case is up to the time of the first operation performed at the hospital. I have since operated three times and kept an accurate record, which I design to embody to a complete history at the termination of the case and to furnish it with full illustrations, photographs and a plaster model for the national museum in Washington.[271]

Buck also contributed to the development of this specialty by a number of case histories for the *Medical and Surgical History* and he published twenty-one articles. In 1876 Buck published the first reconstructive surgery textbook in the United States, *Contributions to Reparative Surgery*, illustrated by a large number of Civil War case studies and which was considered his most influential publication in the development of this specialty.[272] The book consists chiefly of a record of operations, focusing on the remedy of deformities either congenital or the result of burns, gunshot wounds or other accidents. He classed his cases into three categories: loss of parts involving the face and resulting from destructive disease or injury, congenital defects from arrest or excess of development such as hare-lip and cicatrical contractions following burns.

One of his most successful cases was that of William Semmons, Private in Co F 14th New York Heavy artillery, who was wounded at Petersburg March 25th, 1865 by a fragment of shell of the right side of the face and admitted into New York hospital

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[269] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870, Entry 12. A letter from Charles McDougall to Hammond, June 19, 1863 in which he promises to follow up on Buck's operations and have the case histories and photos sent to the museum.
[270] Ibid.
[271] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870, Entry 12. Letter to William Sloan MD. From Gurdon Buck June 18, 1863.
[272] It was actually considered the most important monograph on the subject until after WWI.

October 26th, 1865.[273] His case report noted upon admission that "the face was extensively disfigured." The chin had lost its prominence "owing to the absence of the lower jaw." The lower lip having been "detached by a laceration vertically at the right angle of the mouth and also horizontally by another laceration closing the upper part of the chin nearly an inch below its vermilion border, has adopted below its proper level and becomes adherent leaving a separation between the two lips at the right angle of the mouth of a fingers breadth which exposes the end of the tongue, and there is constant escape of saliva."[274] The patient had lost most of his teeth, was restricted to soft solids and liquids and "articulation is very defective owing to the configurement of the tongue by the adhesions just noticed. In consequence of this defect, the patient is very averse to raising his voice and prefers making himself understood by signs and the use of a pencil and paper."[275] Buck performed the operation November 7, 1865 after the patient had been administered ether. He outlined each stage of the operation in detail:

> The lower lip was detached by a horizontal incision extending along the cicatricial line crossing the chin to a point below the left angle of the mouth, the outer thickness of the lip with its mucous membrane was divided, and the vermillion border which has shrunken into a fair like paw like shape by cicatriculation could now be straightened out and applied to the upper lip throughout its extensive length. To form a new angle for the mouth a point was chosen at the margin of the upper equidistant from the medical line with the left angle, and at this point the border was passed away obliquely. A corresponding point was chosen on the lower lip and faced the same manner—the two fresh cut surfaces were brought into accurate opposition and secured by sutures. The adherent right extremity of the upper lip was dissected up from the alveolar border of the jaw and from this point an incision was carried outward and upward along the upper margin of the cicatrix crossing the cheek as high as the zygoma. The skin and subjacent tissue were detached freely.[276]

Buck then commenced another incision, "Below the left angle of the mouth at a point where the incision detaching the under lip terminated and carried to the right across the border above described as constituting a substitute for the lost jaw." The incision was continued upwards and outward "below and close to the cicatrix as far as the zygoma." Finally he made the third incision:

[273] RG 94 (NARA) Medical Records 1814-1919 "D" File No. 616, Box 14. "Destruction of the body of the lower Jaw and extensive disfigurement of the face from a shell wound." Reparative Autoplastic operation by Gurdon Buck. M.D. Surgeon to New York Hospital.
[274] Ibid.
[275] Ibid.
[276] Ibid.

> Beginning at the starting point of the preceding one below the left angle of the mouth was carried perpendicularly downward at a distance of two inches upon the neck. An upper and lower flap including the entire right cheek and nearly the whole chin were thus formed...After paring off the surface of the cicatrix the edges of the flaps were brought together so as to cover it up and secured by sutures. At this right angle of the mouth; reconstructed in the manner already described, the flaps above and below were matched to the lips and also secured by sutures. Sutures were introduced in close proximity throughout the entire extent of the flaps so as to maintain their edges in accurate adjustment. Four of the sutures were twisted sutures and were inserted, one at the right angle of the mouth, two upon the right cheek at points when they would afford the best support to the flaps and one at the angle of the flap below the under lip. The newly constructed mouth, the lips maintaining themselves in contact and retaining salivary secretions. The adjustment of the different parts to each other was affected without any strain upon the sutures at any one point. No adhesive plaster was used. Liquid nourishment was directed to be given through a tube-water dressing to be applied to the face.

Buck monitored the patient closely, and as he healed, began removing the thread sutures. By November 10, 1865 all of the remaining sutures were removed and while there was a "pus discharge for a few days" it gradually diminished and "every part of the wound healed completely." Buck was extremely pleased with the results and sent before and after photographs of the patient to the Army Medical Museum. The patient was sent home December 12, 1865, when it was observed that "the ability to maintain his lips in contact and thus retain the saliva constituted an immense amelioration of his condition. His improved appearance and some improvement of articulation were also results highly gratifying to the patient."[277]

Perhaps Buck's most successful reconstruction was at St. Luke's Hospital where he reconstructed the face of Elbert Hewitt, a private of Company C, 6th Vermont Volunteers who had been wounded at Winchester, VA September 19, 1864. A fragment of shell that struck his mouth carried away his front teeth above and below, lacerated the under lip at the right angle of the mouth and laid open the right cheek from the mouth to the jaw. The nose and lip were also split vertically and the damage to the face was extensive.[278]Buck waited almost six months to operate. When he performed the first operation he noted that the "injured parts have all cicatrized and the upper lip is drawn in

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[277] Ibid.

[278] RG 94 (NARA) Records of the Adjutant General's Office, Medical Records, Reports of Diseases and Individual Cases, 1841-93, File 'A' and bound manuscripts, 1861-65, Entry 509, box 14: A Case of Autoplastic Surgery Applied to the Face by Gordon Buck MD. Surgeon to the New York Hospital, St. Lukes Hospital.

and adheres to the lower jaw overlapping its alveolar border from which the teeth have been carried away."[279]Because this adhesion produced a "notch capable of lodging the fore finger, which permits a constant escape of saliva to the great annoyance and discomfort of the patient," Buck resolved to reconstruct the patient's face in the hope that he would be more comfortable. The operation took three hours and was carefully documented. Once again he removed the disorganized parts and pared and approximated the sound tissues with sutures to reconstruct the face. The patient suffered some swelling and discomfort immediately following the operation but within a month the sutures were removed and "union by adhesion had taken place in every part of this extensive wound."[280] The patient was up and about, moving through the ward and "regarded his condition as very materially improved." Buck restored Hewitt's articulation and mastication and stopped the saliva from passing through his mouth and he was discharged from service on July 25, 1865. Interestingly, in 1866 he looked for Buck again in the hope of a second operation to improve his mouth, which Buck then performed at the New York Hospital in January, 1866. Once again Buck pared and adjusted the sound tissues and secured them together with sutures and Buck noted that "everything went favorably after the operation, and was highly satisfactory to the patient as well as the surgeon."[281]Buck sent three casts of this case to the Army Medical Museum, all representing different stages of the operation. The first was taken prior to the first operation (number 265 of the Surgical Section of the Army Medical Museum), the second two months after the first operation (number 485), and finally the third cast was taken after the second reparative operation along with photographs of the case (282 of the Photographic Series of the Musuem), proving once again the value and importance as having on-going relationships with the Civil War hospital patients in the development of these specialties.[282]Some patients were examined at "periods from three to seven years after the reception of their injuries" which allowed a broad clinical picture of these surgeries to be established but also reinforced the importance of keeping careful case histories.[283]

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[279] Ibid.
[280] Ibid.
[281] Ibid.
[282] Medical and Surgical History, p. 375. See also, OHA RG 75 (NMHM) "Contributed Photographs."
[283] Ibid. p. 379.

Physicians were asked by Woodward and Otis to provide "detailed histories of cases on the pension rolls," and since many of the patients were listed as severely disabled, they relied on government support and had to submit to personal examinations. With the exception of Buck's work, which was largely lauded for its success and originality, it was suggested that while in some cases "removing the disorganized parts, and paring and approximating the sound tissues by twisted sutures, favorable results may be attained" but "as a general rule, the deformities following gunshot wounds of the face and suggesting some plastic procedure are either accompanied by such extensive loss of tissue or chronic disease of the osseous structures, as to forbid any hopeful undertaking in the way of reparative surgery."[284]Though these operations did not usually restore the patient to his prewar appearance, and were thus considered only marginally successful, the war did allow the development of this very new specialty. In fact, the severity of damage caused by the minie ball demanded surgical interventions to manage this new class of injury. Buck performed them in a specialized ward in the New York Hospital, the Surgeon General and the staff at the Army Medical Museum actively sought the results of these operations and Buck reacted by allowing a body of work to be established in this area. There was now a record of publications, once again detailing with precision the conditions under which to operate, the exact way to perform such operations and how to treat the post-operative patient. Numerous casts and photos were sent to the museum, which established a visual record of these surgeries. Finally, in 1876 Buck published his textbook which was consulted by physicians for decades afterwards. It was considered particularly useful because he outlined in detail his understanding of pedicle flaps, different methods of skin transfer, his technique for performing cheiloplasty for hare-lip and the results of his experimental treatments for discoloration of the face caused by burns, providing a model in which to understand reconstructive surgery. Physicians took pride in being able to restore the faces of these men thereby helping their reintegration into post-war society, and they themselves formed an identity and gained a certain status in working to develop this new and difficult specialty.

[284] Ibid.

Wartime Specialization Evaluated:

The investigations related to the various specializations were by no means complete by the end of the war and in many cases the methodologies employed were more important than the results. All the specialists mentioned here commented frequently that they hoped that their investigations would be elaborated through the further research of other physicians. There was a unique intellectual environment during the war, Circular No. 2 directing the gaze to localized areas of the body, which encouraged physicians to think of disease in more specific terms than they had prior to the war. Circular No. 5 encouraged the transmission of this knowledge. The institutional support provided for by the Union medical department shaped the development of clinical and medical specialism. The innovations in hospitals, in particular specialized wards, along with the formation of the Army Medical Museum encouraged changes in the way physicians approached the study of disease, the practice of medicine and ensured a more widespread recognition of medical specialization.

The publications of the emerging specialist differ in an important way from the medical and case reports submitted by the general practitioner; namely, they outline specific methodologies for studying the specific specialty in which they were engaged. Woodward, DaCosta, Mitchell, Keen and Buck revealed through their research, which was based on a large number of Civil War cases, how to understand, recognize, diagnose, treat and investigate the various disorders they studied. They problematized the issues that they themselves did not fully understand and posed further research questions to be pursued, inviting other physicians into the specialized areas carved out during the war. These men were actors in the process of medical specialization and through their work effectively illustrated the efficacy of specialism in medicine; but they also detailed specific methodologies so that the study of these specialties would continue to develop. There were other similarities in the development of specialties also which suggest that the war was an important stimulus for the development of medical specialization. First, the conditions of the war itself helped determine which specialties would emerge and the ongoing challenges of the war shaped and directed the practice of these specialties. Secondly, specialty hospitals were designated for the study of specific diseases and disorders, allowing and encouraging physicians with the opportunity for the rapid accumulation of specialized knowledge. Third, physicians recognized and welcomed the unprecedented clinical opportunities to develop an expertise in their specialized area of medicine. Fourth, physicians profited professionally from the institutional support of the Army Medical Museum: they eagerly published the results of their experiments, sent casts and photographs to the AMM (to which they were duly credited) and in doing so established identities as specialists. Fifth, physicians published in detail their methodologies, illustrated by Civil War case histories, which created a hierarchy of knowledge with themselves at the top. Finally, and perhaps most importantly, the physicians discussed here maintained continuing associations with their Civil War patients, which added layered dimensions to their research. Now they could study the cases produced by the war and the manifestations of the operations performed or injuries sustained for years afterwards, giving the Civil War physicians a very enviable and unique perspective on these emerging specialties.

Physicians left an interesting body of published work, which was referenced by medical schools and medical professionals around the globe in the post war period and legitimized both the efficacy of medical specialization and the developments in these areas. The unprecedented access to patients and bodies supported the development of medical specialization. Physicians were aware of the need for bodies and pensions or even on-going medical treatment could be withheld if patients did not agree to long term clinical studies and questionnaires. Bodies and patients were used to mould research questions and build large scale collective research projects, but there were struggles that developed between soldiers, physicians, the public and class structures, which resulted from this research being dependent on the specimens and bodies of soldiers.

Chapter Four:
Whose Bodies? Military Bodies and the Politics of Ownership during the American Civil War:

> The field and its ghastly harvest which the reaper had gathered in those fatal hours remained finally with us. Four times it had been lost and won. The dead are strewn so thickly that as you ride over it you cannot guide your horse's steps too carefully. Pale and bloody faces are everywhere upturned. They are sad and terrible, but there is nothing which makes one's heart beat so quickly as the imploring look of sorely wounded men who beckon wearily for help which you cannot stay to give.[1]

Harper's described this scene immediately following the Battle of Antietam. It aptly describes the unprecedented number of deaths Americans had to face and the mass of bodies created by the war. Medicine developed significantly during the Civil War years in large part as a result of two prized means of research, bodies and patients.[2]In antebellum America these were limited resources. The relationship between the physician and the "dead body" was contested in nineteenth-century America. Today the Uniform Anatomical Gift Act of 1968 provides for the procurement of unclaimed bodies by medical schools.[3]In antebellum America, although most states allowed criminals to be dissected, not enough people were executed to fulfill the increasing demands of the medical profession. Medical training (of which anatomy was the corner stone at the time) was consequently severely hindered, forcing medical students to go abroad for their training or to resort to grave robbing, which was both illegal and socially unacceptable. Michael Sappol discusses the public's distress over dissection, which at least seventeen anatomy riots in America between the years 1785-1855 manifested.[4]States increasingly passed anatomy acts to control the availability of bodies, but the public rejected them and the dissector, who was, as Sappol suggests, viewed as a "butcher who reduced the human body to the status of thing, to the condition of meat."[5]Helen MacDonald has similarly shown that in the same period in Britain many people viewed medical men who purchased bodies for dissection as "monsters" because they acted "far outside what was acceptable to the society in which they lived."[6]Of five anatomy acts enacted in the U.S.

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[1] Harper's New Monthly Magazine, Oct. 4, 1862, p. 634.
[2] Prior to the war, extensive hospital experience was usually reserved for the elite.
[3] Each state has its own version of the statute.
[4] Michael Sappol, *A Traffic of Dead Bodies: Anatomy and Embodied Social Identity in Nineteenth- Century America* (Princeton, Princeton University Press, 2002) p. 4.
[5] Ibid.
[6] Helen MacDonald, *Human Remains: Dissection and its Histories* (New Haven: Yale University Press, 2005) p. 30.

prior to the 1860s three were repealed, leaving only two states with such legislation on the eve of the Civil War.[7]

As a result, as discussed in chapter 1, hospital medicine was slow to develop among the majority of American practitioners. Surgeon General William Hammond and other elite physicians were keenly aware of this and Circular No. 2 was part of the Union medical department's systematic attempt to develop medical science. For the first time in American medicine there was an official directive that provided ample bodies and specimens to American physicians. The Union medical department's effort brought an unprecedented number of American physicians into the domain of medical science and the openness of the project of collecting specimens and performing autopsies supported a new claim for scientific authority. This focused study of diseased structures provided a unique opportunity to educate physicians on the basic principles of medicine, in many ways bridging the experiential separation between those who had studied in Paris and those who had only read about such experiences. As the rank and file of the medical profession responded to the demands of the circular, the weakness in the training of American physicians was quickly exposed which provided a justification for continued anatomical education. The war came along at an important juncture in American medicine. Physicians realized that access to bodies offered a unique opportunity both to become producers of medical knowledge and also to orient American medicine along the same lines as elite European medical practice. But there was an important and unprecedented dimension to the wartime dissection of bodies: by expanding medical knowledge, those still living and fighting had a greater chance of being saved. Cutting open the body and seeing the disease or gaining fresh understanding about the way in which it functioned might offer better insight into managing the pervasive diseases that dominated during the war. Bodies enabled doctors to research and search for cures in the name of science; and the advance of science promised new and important developments in medicine.[8]

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[7] Sappol p. 5. He has demonstrated how the failure of the passage of these acts led to a veritable "traffic of dead bodies" or a climate in which body snatching was compelled to flourish.

[8] It is interesting to note that almost every single project, letter asking for a microscope, official directive regarding medicine etc. promised scientific advancement. It was absolutely a goal of the physicians who served during the war to advance scientific medicine.

While some doctors were clearly overwhelmed, others welcomed the opportunity to develop their own skills and contribute to the advancement of American medicine. Part of this enthusiasm came from working with bodies and patients. An interesting thing happened: as doctors became more comfortable with the body, they began to speak in a scientifically structured rhetoric about the patient, illustrating the shift that took place with the war. Collecting specimens, as required by Circular No. 2, anatomized the body separating it from the identity of the patient. When a patient died or was close to death the issue was less the specific patient and more the "specimens" that were obtained. This helped to establish a common language and a medical elite,[9]an experiential distinction from those who lacked such access to bodies. The Army Medical Museum provided important institutional and authoritative support for the collection of specimens, which were dissected and studied, demonstrating the value of military bodies. The dissection of bodies and the specimens thus derived were not hidden as they had been prior to the war; they were prominently displayed, not as medical curiosities but as valued contributions to the national cabinet established to "study the problems regarding the diminution of mortality and for the alleviation of suffering in armies."[10]The mandatory case study that accompanied bodies and specimens, required by Circular No. 5, legitimized the dissection of the patient by making his death useful for both Civil War physicians and the soldiers who would benefit from the knowledge generated. The contests over dissections in the nineteenth century have been well documented[11]—but what about during the war years? Most narratives have focused on the procurement of society's vulnerable bodies: the poor, the homeless, the powerless, the unclaimed or black bodies that were "exploited" by the medical profession in the name of scientific advancement. In the war

[9] By supporting a hierarchy of knowledge within the profession.
[10] RG 94 (NARA) File A Entry 642 "Notes on Contributions to the Army Medical Museum" By George Otis, Asst. Surgeon U.S.A. Feb. 7, 1878.
[11] See, Michael Sappol, *A Traffic of Dead Bodies: Anatomy and Embodied Social Identity in Nineteenth- Century America* (Princeton, Princeton University Press, 2002); David C. Humphrey, "Dissection and Discrimination: The Social Origins of Cadavers in America, 1760-1915," *Bulletin of the New York Academy of Medicine* (1973): 819-27; Suzanne M. Schultz, *Body Snatching: The Robbing of Graves for the Education of Physicians in Early Nineteenth Century America* (North Carolina, McFarland and Co. Inc., 1992); John Harley Warner, *Against the Spirit of the System: The French Impulse in American Medicine* (Princeton, 1998); Ruth Richardson, *Death, Dissection and the Destitute* (Chicago, The University of Chicago Press, 2000); Todd Savitt, "Use of Blacks for Medical Experimentation and Demonstration in the Old South, *Journal of Southern History* 48 (3): 331-348.; Sharla M. Fett *Working Cures: Healing, Health and Power in Southern Slave Plantations (*Chapel Hill: The University of North Carolina Press, 2002) and John Duffy, *From Humors to Medical Science: A history of American Medicine* (Chicago: The University of Illinois Press, 1993).

the vulnerable were no longer targeted; rather soldiers' bodies were dissected to understand and even master camp diseases and wounds and generate knowledge that would benefit the living. Anatomical practice during the war is an important but neglected period in the development of American physicians.

Through a series of case studies, this chapter will attempt to show whether or not attitudes about dissection changed during the war; how physicians learned from both the living and the dead body; and the contests that developed over military bodies. In contrast to the heated debates between body snatchers and the public prior to the war, the chief conflicts during the war were between individual physicians and the staff of the Surgeon General's Office over the ownership of bodies. Having clinical access to patients and bodies enabled physicians to develop their skills by conducting clinical studies, research and experimental medicine, which created a foundation for the medical sciences (including specialism, laboratory medicine and especially practical experience and knowledge of the body). The wartime ownership of bodies thus politicized the body by laying the basis for the study of medicine that would grow into demands for anatomy legislation after the war. There was now a written record of experience, including unpublished case records, the six volumes of the *Medical and Surgical History*, and countless journal articles illustrating the need for bodies to understand disease and produce the knowledge necessary for the development of American medicine. This enabled physicians to establish their own identities as producers of medical knowledge but they had to work within the structure of the military medical department. A close relationship between an individual physician and the medical department allowed significant developments in a physician's professional career. But it was a complex process of professionalization, with the competing priorities of doctoring to save the lives of soldiers and attempting to complete anatomical training being intertwined. The dissection of wartime bodies was also sometimes contradictory. For example, physicians justified the "exploitation" of the individual body because it would ultimately benefit the national body as physicians advanced their own research objects. Civil War physicians also gained power from their wartime access to bodies and patients. As a result they developed knowledge in a variety of ways. This chapter investigates the forms in which military bodies stimulated new areas of research, including new strategies to understand

and master two conditions that were manifested during the war: death from chloroform and malingering.

Death in Nineteenth-Century America

During the Civil War, Walt Whitman constantly wrote to his mother about his hospital visits and recorded his experiences, in which he detailed the courage and sacrifice of the young men he met.[12]His diaries and letters provide an excellent insight into how death was perceived during the war as he commented on it frequently and reflectively: "Somehow I got thinking today of young men's death—not at all sadly or sentimentally, but gravely, realistically, perhaps a little artistically."[13]He found reminiscing about death not gloomy or depressing but rather "soothing, bracing, tonic."[14] He was not shocked by the death he saw but rather admired the bravery exhibited by the men as death approached:

> One night in the gloomiest period of the war, in the Patent Office Hospital in Washington City, as I stood by the bedside of a Pennsylvania soldier who lay, conscious of quick approaching death, yet perfectly calm with noble, spiritual manner, the veteran surgeon, turning aside, said to me that though he had witnessed many, many deaths of soldiers and had been a worker at Bull Run, Antietam, Fredericksburg etc., he had not seen yet the first case of a man or boy that met the approach of dissolution with cowardly qualms or terror. My own observation fully bears out these remarks.[15]

It was so commonplace there was a detachment about death, as Whitman observed of a patient in Armory Square hospital after the Battle of Gettysburg:

> Notice the water-pail by the side of the bed, with a quantity of blood and bloody pieces of muslin, nearly full; that tells the story. The poor young man is struggling painfully for breath, his great dark eyes with a glaze already upon them, and the choking faint but audible in his throat. An attendant sits by him, and will not leave him till the last; yet little or nothing can be done. He will die here in an hour or two, without the presence of kith or kin. Meantime the ordinary chat and business of the ward a little way off goes on indifferently.[16]

It was death without "kin" present that was so different from antebellum America where people usually died at home with death rituals including bathing, grooming, posing and

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[12] Walt Whitman, *The Wound Dresser: A Series of Letters Written from the Hospitals in Washington During the War of the Rebellion* (ed.) Richard Maurice Bucke (Boston: Small, Maynard and Company, 1898).
[13] Walt Whitman, *Specimen Days and Collect* (Glasgow: Wilson and McCormick, 1883) p. 106.
[14] Ibid.
[15] *Walt Whitman's Civil War* (ed.) Walter Lowenfels (New York: De Capo Press, 1960) p. 285.
[16] Walt Whitman, *Specimen Days and Collect* (Glasgow: Wilson and McCormick, 1883) p. 45.

photographing the corpse.[17] Americans objectified the dead and went to great lengths to honor the corpse in antebellum America but during the war, as Gary Laderman has demonstrated, there was a "reconceptualization of the meaning of the corpse and of death in general."[18] For the first time, many American families had to learn how to grieve for their loved ones without the presence of the corpse.

While some families were forced to come to terms with losing a loved one and never seeing the body again, some families arranged for it to be sent home. But it was not an easy process. Abigail L. Johnson lost her son to disease in December of 1862 and attempted to have his body returned for burial:

> In the absence of my husband I buried the remains of one son that was sent home to me (Henry). Soon after, I saw the death of my other son Frank, in the daily papers. I made arrangements for his burial in my other son's grave and was going to have them both in one grave when to our sad disappointment it proved to be the body of a stranger. I had to bear up with fortitude when I saw the mistake. There instead of the remains of my noble son were the remains of a small man, while I looked upon him I thought that perhaps there were hearts bleeding for him and my son's remains might be lying alone and rejected in some lonely spot... My son's name was on the bosom of this man's shirt. I suppose that the name of this man is on the slab at my son's grave. You wrote my daughter that the way that you found out where he was from by a letter written by her and found among his clothes. You said that you conversed with him: did you hear him say anything about friends and home or was he too weak to talk? I should like to be informed. The circumstance of his death seems to be enveloped in darkness. Oh when will war and bloodshed cease from our lands? When will fathers and mothers have their sons at home to die with them and have the mournful comfort of preparing their bodies for the grave? This is from a mother in affliction.[19]

Handling bodies during the war was sometimes problematic and the above case in particular led to demands for the greater care of diseased bodies.[20] The Quartermaster Department, who was charged with the burial of soldiers, was notified:

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[17] For antebellum death rituals and attitudes about death see, Harriet A. Washington, *Medical Apartheid: The Dark History of Medical Experimentation on Black Americans from Colonial Times to the Present* (New York: Harlem Moon, 2006); Franny Nudelman, *Slavery, Violence and the Culture of War: John Brown's Body* (Chapel Hill: The University of North Carolina Press, 2004); Gary Laderman, *The Sacred Remains: American Attitudes Toward Death, 1799-1883* (New Haven: Yale University Press, 1996); Drew Gilpin Faust, *This Republic of Suffering: Death and the American Civil War* (New York: Knopf, 2008); Mark S. Schantz, *Awaiting the Heavenly Country: The Civil War and America's Culture of Death* (Ithaca: Cornell University Press, 2008).

[18] Laderman, p. 10.

[19] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870. Entry 12, Box 11. Letter from Abigail L. Johnston to Mr. W.H. Sigston, Warden Master, Jan. 16, 1863.

[20] In particular, the establishment of the Graves Registration Service, the designation of national cemeteries for soldiers that died in the service of the country and the government burial of fallen union soldiers. See, Gary Laderman, p. 119.

> In order to enable friends of deceased officers and soldiers to exhume bodies and to establish beyond a question the identity of the body to be exhumed, I have devised a system which will aid in identification. I have requested the surgeons of the general hospitals to pin upon the breast of the deceased a carde containing his name and description, this can be buried with the body. The object is to prevent any mistake which may occur in exhuming the wrong body from going beyond the cemetery. I have on file many cases of negligence of parties at the hospitals tending to confuse burial records and to defeat my best efforts to procure for the friends of the deceased officers and soldiers the melancholy pleasure of having them rest near the graves of their kindreds, but the preoccupation of my office have hitherto and so now prevent my presenting for higher consideration many cases of a peculiarly distressing nature.[21]

The public often objected to the callous treatment that dead bodies sometimes received. For example, on June 19, 1862 C.H. Alden of the Surgeon General's Office issued a letter reprimanding "certain parties connected with several of the city hospitals, hospital stewards and chaplains especially" who were reportedly "engaged in highly improper practices with reference to the disposition of the remains of deceased officers and soldiers deceased in the hospital of this city."[22]All bodies were ordered to be turned over to the authorized undertaker Mr. F. Sands and "no Chaplain or hospital steward connected with the hospital will interfere in any manner with the proper performance of his duties."[23]

Some families wanted the return of the corpse, if only to see it one last time in a semi life-like state, and thus turned to embalmers. Prior to the war, embalming was used by medical schools to preserve corpses for dissection but the practice had not been followed in burial for regular citizens; most who wanted to preserve the corpse resorted to coffins on ice.[24] Civil War led to an unprecedented demand for embalming. This consisted of a chemical injection[25](usually through a femoral artery) after which the embalmer would ship the body home. It cost fifty dollars to embalm and send an officer home and twenty-five dollars for an enlisted man.[26]Embalming was used primarily by families with money, a fact not lost on the physician Oliver Wendell Holmes who observed after Antietam: "the slain of higher condition, 'embalmed' and iron-cased, were

[21] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870. Entry 12, Box 11. To the Quarter Master General from Capt. E.L. Hartz Jan. 19, 1863.
[22] RG 112 (NARA) Central Office Issuances and Forms, Circular and Circular Letters of the Surgeon General's Office, 1861-1885. Entry 63. From C.H. Alden Issued June 19, 1862.
[23] Ibid.
[24] Laderman, p. 113. The strides made in embalming during the war would contribute significantly to the development of the funeral industry and the professionalization of the undertaker. See Faust, p. 92.
[25] A number of preservatives were used including permanganate of potassa, arsenic, zinc, various salts and chloride.
[26] See, Alfred Bollett, *Civil War Medicine: Challenges and Triumphs* (Tucson: Galen Press, Ltd., 2002) p. 465.

sliding off on the railways to their far homes; the dead of the rank and file were being gathered up and committed hastily to the earth."[27] As Drew Gilpin Faust demonstrates, "public discomfort with embalmers appeared most often in regard to the issue of money and the unsettling commodification of the dead that their business represented."[28] Still embalming flourished[29] and the federal government even sanctioned the preservation of corpses.[30] The relationship between embalmers and the regular medical profession was not always smooth; in fact, the medical department viewed embalmers as an "unmitigated nuisance"[31] since they were competing for bodies. Drs. Brown and Alexander the owners and operators of "Embalmers of the Dead" in Washington enterprisingly contacted Hammond shortly after Circular No. 2 was issued to offer their services:

> As we understand you propose to establish in this city a national cabinet of surgical anatomy to be made up by contributions from the casualties of the war, and as we believe that we could under your efficient service help in preparing your specimens so as to effectively preserve them from decay, and also by copying them in wax. While still fresh, to a life like perfection, thus producing one of the greatest combined cabinets the world ever saw. We alone use by right of purchase the system of Professor Suquet of Paris for embalming and putrefying the dead either in the whole or parts of the bodies. We should be happy to be allowed to take charge of the entire cabinet, and preserve and arrange the specimens as they may be presented.[32]

Hammond rejected this proposal but it well illustrates the contest over bodies. Some families did make arrangements with Frank T. Sands, a government undertaker in the city of Washington, for their sons to be returned but it was costly and difficult to organize. Americans were thus forced to approach death differently as a result of the war. Mark Schantz suggests that nineteenth-century Americans faced death with a "calm resignation" for religious reasons, because they believed "a transcendent beauty awaited them beyond the grave" and their "heroic achievements would be cherished forever by posterity."[33] Death was an integral part of American culture and the fascination[34] and

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[27] Quoted in Laderman, p. 114.
[28] Faust, p. 96.
[29] A number of embalming companies were formed and they ran numerous advertisements in local papers offering their services—and most promised that their methods would leave the body looking life-like and "marble like in character."
[30] Laderman, 114.
[31] Faust, p. 97.
[32] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870. Entry 12, Box 11. From Drs. Brown and Alexander to Hammond, Nov. 26, 1862.
[33] Schantz, p. 2.

preoccupation with it, along with the belief in eternal life made it "easier to kill and be killed" during the Civil War.[35]But while Americans accepted death and approached it with both courage and calmness there was a new and challenging scale of bodies to contend with during the war.

The medium through which Americans saw these deaths was also new. As William C. Davis has said: "the camera never stopped. Wherever armies went, the Cyclops eye followed. To the battlefield, to the home front, at sea, on the march photographers turned their instruments toward whatever caught their interest."[36] Photography was a novel technology in 1861. Americans were fascinated with the idea of shadowed images on glass, paper and metal and the scenes of war that photographs provided. Davis says that "there was a steady demand in the North for war views."[37] Alexander Gardner's photographs, in particular, showed the thousands of dead "lying singly" and "heaped in piles" as the casualties were literally "falling in rows."[38] Images like his "Harvest of Death" after Gettysburg, the scene of Lee's defeat in 1863, described by Gardner simply as "devilish!", graphically revealed the dead strewn on the field with shoes removed (for the survivors) and pockets turned inside out,[39]waiting to be buried or claimed by the medical department. As Walt Whitman wrote: "the dead in this war—there they lie, strewing the fields and woods and valleys and battlefields of the south—Virginia, the Peninsula—Malvern Hill and Fair Oaks—the banks of the Chickahominy—the terraces of Fredericksburg—Antietam Bridge—the grisly ravines of Manassas—the bloody promenade of the War department…"[40]

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[34] Faust demonstrates that battle sites were a "focus of wonder and horror" and became "crowded with civilians immediately after the cessation of hostilities" some were looking for loved ones, some were embalmers, still others just wanted to "gratify their morbid curiosity." P. 85.
[35] Ibid.
[36] *The Image of War: 1861-1865 The Embattled Confederacy*, Vol. III (ed) William Davis (New York: Doubleday, 1982): p. 9.
[37] *The Image of War: 1861-1865, Shadows of their Storm Vol. 1* (ed.) William Davis (New York: Doubleday, 1981) p. 9. He also notes that there were more than 3000 photographers that could capture the images of war.
[38] Ibid. pp. 38-41 Gardner's images literally capture the thousands of dead bodies after the Battle of Antietam. They lie dead all over the fields. Some scenes are so profound, for example the Confederate dead in the 'Bloody Lane" see pp. 49, 50, 59. Many of these images were printed in Harper's Weekly providing a stark view of the reality and destructiveness of the war. Gardener also published his 'Photographic Sketchbook of the War Vol. I" immediately following the war.
[39] Alexander Gardner, *Gardner's Photographic Sketchbook of the American Civil War 1861-1865* (New York: Delano Greenridge Editions, 2001) First published by Philip and Solomons, Washington DC, 1866. For the "harvest of death" see p. 81, plate 36.
[40] Whitman, Specimen Days, p. 79.

In addition to sheer numbers the unprecedented indignities to the dead were difficult to accept. Whitman commented on "the varieties of the *strayed* dead" the "national soldiers kill'd in battle and never buried at all, 5000 drown'd—15,000 inhumed by strangers, or on the march in haste" in graves that were merely covered by "sand and mud."[41] He spoke of the ravages of disease or the "mighty reaper," including the deathly effects of dysentery, inflammation and typhoid. Men were sometimes forced to die alone "in bushes, low gullies, or on the sides of hills" where the only reminder might be a "skeleton, bleach'd bones, tufts of hair or fragments of clothing."[42]Whitman also lamented the indignity to corpses, which sometimes "floated down the rivers" or "lie at the bottom of the sea"; but perhaps the greatest indignity of all was "on monuments and gravestones, singly or in masses, to thousands or tens of thousands, the significant word **Unknown.**"[43]Many soldiers feared this fate and pinned letters or name tags to their uniforms. Contemporaries were nevertheless overwhelmed with what Faust has called "the work of death."[44]As she also demonstrates, indignity to the corpse, death without burial or even recognition in death, proved to be a real challenge for the living who now had to understand and explain death in this new context.[45]As Gary Laderman points out: "the exigencies of combat ensured that what had been considered proper and respectful treatment of the dead in peacetime no longer applied during the war."[46]But it was simply not possible to honor all corpses or engage in traditional funerary rites; as a result the attitudes regarding the responsibility of the living towards corpses changed through the war.

These changing attitudes were also present in the medical profession. Many American physicians clamored to doctor in the war and part of the attraction was the availability of bodies. Elite physicians in antebellum America, particularly those that had

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[41] Ibid.
[42] Ibid.
[43] Specimen Days, p. 80. Whitman further observed that in some prisons such as Salisbury, N.C the known are only 85 while the unknown are 12,027 and 11,700 of these are buried in trenches. Of the National Monument erected by Congress Whitman noted, "what visible, material monument can ever fittingly commemorate that spot?"
[44]See, Drew Gilpin Faust, *This Republic of Suffering: Death and the American Civil War* (New York: Knopf, 2008. Her book examines "the work of death" how it was managed, risked, endured, understood, prepared for and its long term effect on society.
[45] Faust, p. 268. Some people turned to embalming to separate the distance from the living and dead, but more practically, Congress passed a resolution to establish national cemeteries intended to memorialize the dead—but this was a transformation in the way death was handled by Americans. Faust pp. 99-101. See also Laderman chapter 9, in which he discusses the federal government's handling of the remains of union soldiers.
[46] Laderman, p. 103.

been to Paris and/or Berlin and Vienna, understood the importance of the anatomical perspective in medicine but this was still a relatively small group of physicians (less than a thousand had studied abroad prior to the war) and although the effect of their training was much larger than their numbers would suggest,[47] hospital medicine did not find its first significant outlet in America until the Civil War. Part of this was because students who did not have the benefit of foreign travel but who only eagerly read about the European experiences of their peers still had trouble obtaining bodies.[48] Most medical schools required students to perform a dissection (with a group or alone with a preceptor); but that meant that students may have performed only one or two dissections and had minimal experience with the body. Students had little opportunity to master the body - how it functioned, the easy recognition of specific diseases - or even become familiar with its structure, which produced a deep professional divide and a medical elite.[49] While many elite allopaths clamored for bodies prior to the war, not all practicing American physicians shared their faith in the transformative power of anatomy. John Harley Warner demonstrates that "elite physicians valued their learning and often disparaged their ill-educated compatriots" because there was generally a belief among the "many" that "scientific expertise was not a necessary criterion for membership in the regular profession."[50] Physicians in antebellum America needed to know about the practice of medicine rather than the science behind it to maintain a respectable professional identity.[51] This largely changed during the war. As demonstrated in chapter one, Circular No. 2 demanded that autopsies be performed in all cases where practicable, as a matter of professional interest. This was commensurate with the practice of the Paris Clinical School where free access to bodies allowed regular dissections; but in Paris

[47] See, John Harley Warner, *Against the Spirit of the System: The French Impulse in Nineteenth-Century American Medicine* (Baltimore: The Johns Hopkins University Press, 1998) Chapter 4.
[48] For example the elite physician Valentine Mott was convinced about anatomical study and dissections as the corner stone of medical education, but this was after he worked with prominent anatomists in Europe (Abernathy, Bell, Cooper and Monro). He also maintained a large collection of specimens for teaching aids. See, Suzanne M. Schultz, *Body Snatching: The Robbing of Graves for the Education of Physicians in Early Nineteenth Century America* (North Carolina, McFarland and Co. Inc., 1992) p. 49. Schultz also acknowledges that Mott was a "body snatcher par excellence." Valentine Mott, however, volunteered to serve in the war for the experience of working with soldiers and developing techniques as a surgeon. He was the first surgeon to tie both carotid arteries and wrote articles and a monograph on how to arrest hemorrhage from wounds. See, Valentine Mott Correspondence, National Library of Medicine, Washington DC MS C 281
[49] Between the rank and file (who generally did not have access) and the elite but also alternative sects (who generally did not believe in anatomical study).
[50] Warner, *Against the Spirit of the System* p. 263.
[51] Ibid.

physicians practiced surgical operations on cadavers. During the Civil War physicians performed surgical operations on living patients for the express purpose of saving lives. The war thus proved to be a unique medical experience for many physicians, even those who had studied in Paris. There was also a certain autonomy about the war experience that differed in an important way from Paris: American physicians were dictating the way in which medicine was structured and practiced. This was different from the individualized training that many physicians sought from study in Europe and was important in supporting the development of distinctive American medicine. Thousands of physicians who performed autopsies now actually saw the lesions caused by disease as they dissected patients and came to associate specific symptoms with specific diseases.[52] Dissection changed the way many physicians thought about medicine and disease, as numerous physicians commented on how valuable the autopsy was for understanding the manifestation of disease.[53]

Physicians, however, were not merely opportunistic dissectors capitalizing on dead bodies during the war; but their attitudes to the body, all bodies (not merely the poor or vulnerable), did change during the war.[54] Death became almost completely associated with scientific medicine and was to some extent institutionalized within the Army Medical Museum. Physicians wanting to improve medical knowledge and contribute to the advancement of medical science truly believed that the bodies and specimens produced by the war would lead the way to developments in medicine. Laderman suggests that prior to the war doctors had to convince the Protestant community "that their fascination with the dead was legitimate and valuable to the health of society" and that they "needed an opportunity to make the public recognize that medical knowledge and death share common ground."[55]The war provided an unprecedented opportunity for

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[52] As I read through the autopsy reports I was struck by how empirical and short they were or how they lacked confidence early in the war. But by 1863 specific diseases based on symptoms are quickly and easily recognized. You can see the confidence develop through the war, which is really interesting.
[53] The thousands of autopsy reports, most unpublished, and housed at NARA or the NMHM often have physicians commenting on how valuable the autopsy is for understanding the manifestation of diseases.
[54] There was an important class dimension to the project, however. Woodward noted of the museum's collection in 1871 "mention must also be made of a shelf in which side by side specimens derived from the mutilated limbs of seven general officers. Need it be said that no critical eye could distinguish them from the similar mutilations of subalterns or of private soldiers?" The collection was primarily made up of privates most of whom were immigrants. Woodward, Lippincotts, 1871 p. 236. There is a racial dimension as well. When the war ended in 1865 the doctors at the AMM turned to the black bodies in the newly formed freedmens hospital to keep the project going (e.g. access).
[55] Laderman, p. 85.

the medical community to convince the public of the efficacy of dissections. Contrary to Laderman, however, who suggests that the medical profession had a "fascination with the dead," this study suggests that the desire to dissect bodies during the war was far more complex than mere fascination with the dead. There was a new relationship between disease and the body: these were national bodies that both needed and deserved the most up-to-date medical knowledge. Once a doctor had performed his first few autopsies[56] the "mystery" of the internal body was to some extent revealed and it became less a fascination with dissection[57]and more a matter of mastering the diseases that ravaged the soldiers who could benefit from the doctor's new found knowledge.

Doctors undertook major studies and research initiatives on a variety of diseases. Some read Virchow's lectures and then studied tissues and cells with the microscope while others aimed to understand unfamiliar diseases through experimentation and the use of different remedies. They studied the effects of specific diseases on each organ and examined the path of missiles, hoping to create a body of knowledge that would benefit American soldiers not only in the Civil War but also future wars. The fascination with the body evolved within the intellectual climate of the war. Disease was considered to be part of the body (most doctors maintained a physiological conception of disease causation) but during the war medical understanding moved from morbid anatomy to experimental medicine which aimed to understand the disturbances in normal function caused by camp diseases. As shown in the investigations of gangrene and erysipelas, medical practice became more about trying to control bodily systems or to introduce therapeutics to prevent or cure the disease than about anatomy. There were of course some cases of doctors stealing body parts in the hopes of making a pathological cabinet because of the cultural fascination Americans had with the body (to be discussed below); however, the case reports overwhelmingly show that most physicians wanted to understand diseases better. Those in the field were consistently reminded that their case reports would be

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[56] Autopsies were performed at field hospitals, in general hospitals, in conjunction with peers, alone, as part of the new medical model stimulated by Circular No. 2. Some physicians would hand in a quarterly reports and/or the case book would have hundreds of autopsies. See, RG 94 (NARA) Medical Records, 1841-1919 Entry 621-3 Files A and D.

[57] I would also suggest here that because physicians went to such great lengths to obtain bodies before the war (such as grave robbing, working with a resurrectionist, or traveling to Europe) that it supported a fascination with the body once the physician finally had it in hand. Physicians went to such great lengths, there would be little doubt he would study and preserve the body extensively. I have read thousands of autopsy reports and the sense I get about medicine overall during the war, however, is that there was a maturity and development to the way in which disease was studied and how the body was posited generally.

published in *Medical and Surgical History,*[58]which would be distributed to many repositories in Europe.[59]While Laderman contends that "scientific and medical perspectives on the dead body gained legitimacy during the war and contributed to a shift in understanding the meaning of death,"[60] he neglects to examine how access to bodies helped develop specific aspects of American medical science, the complex nature of assuming ownership of military bodies and the limitations of the war. By 1880 the physician W.W. Keen was once again lamenting the lack of bodies available for medical study in America.[61]

The broader professional context of the case histories as a vehicle for developing medical practice and study is clearly illustrated through the thousands of reports that were submitted to the Army Medical Museum. These generally reveal that physicians engaged with some of the most pervasive diseases and difficult medical challenges in the hope of finding the means of prevention or effective treatment. For example, why did "tubercules supervene on the lungs" after a gunshot fracture of the knee joint?[62]Or, after amputation of the femur was pyemia more likely to occur; and if so, why?[63]Physicians studied the body hoping to gain clues about why and how wounds and diseases became fatal and published their findings in the hope that both doctors and patients could benefit. For example, physicians found pyemia (infections spread through the bloodstream) extremely difficult to treat and because the infections spread so quickly the mortality rate was 92%.[64]Joseph Woodward spearheaded a number of experiments for its treatment, hoping to develop a means to help soldiers vulnerable to infection. He asked a few elite physicians to conduct experiments on the therapeutic value of alkaline sulphites. The physician Walter Atlee experimented with bisulphate of soda in purulent infection; M.

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[58] Hammond issued a Circular letter May 4, 1863, which requested that all medical officers be "appropriately noted in the surgical and medical history of the war" he found that this promised recognition motivated physicians to submit specimens, case reports and essays. See, Curatorial Records" Circulars and Reports, RG 6 Box One Otis Historical Archives (NMHM).

[59] It is interesting that many elite physicians such as Mitchell, Keen, Hammond, Woodward etc. begin their reports with phrases like "this seems to be unknown in Europe" or they challenge accepted ideas about specific diseases (such as Rokitansky on gangrene and Guthrie on Erysipelas).

[60] Laderman, p. 85.

[61] W.W. Keen's Correspondence, 1860-1931, Library of the College of Physicians, Phil.MSS 2/0076-04, Box I Ser 1-2.

[62] RG 94 (NARA) Reports of Diseases and Individual Cases File A, Entry 867 " History of Pathological Specimens Forwarded to the AMM "Case of Gunshot Fracture of the Knee Joint" submitted by H.M Bellows

[63] Ibid. Case of John Smith "Fracture of the Left Thigh in May 3, 1863 at the Battle of Chancellorville" submitted by William Thomson.

[64] See, Alfred Bollett, *Civil War Medicine: Challenges and Triumphs* (Tucson: Galen Press, Ltd., 2002). P. 197.

Carey Lea studied the transformation of alkaline sulphites in the human system; and T. Spencer Wells examined the causes of excessive mortality after surgical operations and the therapeutic value of alkaline and earthy sulphites in the treatment of catalytic diseases.[65] Woodward was most encouraged by Atlee's successful experiments and suggested to Barnes that sulphite of soda "be furnished for trial to such groups of general hospitals as the Surgeon General may direct."[66] He further recommended that a select group of physicians be designated to "make the observations in the class of cases to be dealt with."[67]

Laderman is correct that there was a "shift in the meaning of death" among the Protestant community during the war from which medical professionals benefited; but access to bodies was far more significant because it allowed the development of scientific medicine and legitimized the dissection and dissector. Framing the project as a stimulus to scientific medicine was intended to appeal to the orthodox medical profession's desire for improvement, respectability and professionalization. Access to bodies en masse was a unifying factor for the medical community—a shared experience and common knowledge. Medical practice during the war underwent a revolution, not in the ability to cure disease but rather in having more physicians than ever become familiar with anatomical practice. This accelerated anatomical training enabled physicians to see the limits of localized pathology in explaining the function of disease, which supported the development of new approaches to medicine, including physiology, chemistry, pharmacology, cellular pathology and paved the way for the acceptance of bacteriology. Perhaps most importantly, however, the deep divide between the rank and file and the elite that existed prior to the war shrunk significantly. For a time the medical community in America became more cohesive as Woodward recalled:

The number of visitors to the collection constantly increases. There has been a cordial collaboration on the part of surgeons in charge of hospitals, and an entire harmony and concert of action between the medical and surgical departments of the museum. The

[65] See, Walter F. Atlee, "Two Cases of Pyemia of Purulent Infection with Recovery in which the bisulphate of Soda was administered." *American Journal of Medical Science* (Jan. 1865): 82; M. Carey Lea, "On the transformation of Alkaline Sulphites in the Human System." *American Journal of Medical Science* (Jan. 1865): 82; Spencer T. Welles, "Therapeutic Value of the Alkaline and Earthy Sulphites in the Treatment of Catalytic Diseases" *American Journal of Medical Science* (Jan. 1865): 236.
[66] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870. Entry 12, Box 109. Letter from Joseph Woodward to Joseph Barnes, March 28, 1865.
[67] Ibid.

museum already occupies no mean place among scientific collections, and may be regarded as an object of just pride to the medical staff of the army.[68]

As physicians used the body to develop scientific medicine and legitimized it by publishing their results, it changed the way the work of the orthodox physicians was framed in society. Sappol argues that in antebellum America the doctor/dissector "assumed a key role in the death narrative" because he "pinned a moral conclusion to the life story of the deceased, and rendered judgment."[69]He further suggests, however, that doctors were not the sole authority in antebellum America; they competed with the ministers "who also asserted moral conclusions about the life lived, and relations between the two authorities were tricky."[70]But medical authority was gaining authority in antebellum America as Sappol demonstrates, and this study suggests that the war proved definitive in this transformation. When the public visited the medical museum they saw five departments: surgery, medicine, anatomy, comparative anatomy and microscopy, each filled with the preparations obtained from military bodies, which had been diagnosed, prepared and dissected by American physicians. People saw the long rows of glass cases which held prepared specimens and were "aware of the nature of the collection by the strong smell of carbolic acid."[71]They examined the "interesting cases" such as John Wilkes Booth's spinal cord from the cervical region (which was torn and discolored by blood), "transversely perforated from right to left by a carbine bullet, which fractured the laminae of the fourth and fifth vertebrae."[72]They examined skulls with gunshot wounds, gunshot wounds to every part of the body, wounds caused by arrowheads and bayonets, specimens of disease illustrating morbid processes of every kind and samples of diseased organs, malformations, parasites, concretions and calculi. Visitors were also allowed into the museum's microscopial collection, perhaps the most scientific division of the museum, which was described as "one which was not surpassed anywhere not even in the medical school in Paris."[73]Finally they saw photomicrographs, read the extensive and brief medical case histories of the Civil War soldiers and even

[68] Quoted in Daniel Lamb, *History of the U.S Army Medical Museum, 1862-1917: Compiled from the Official Records of Dr. Daniel S. Lamb Pathologist at the Museum* (Washington: Army Medical Library, 1917) p. 36
[69] Sappol, 41.
[70] Ibid. 42.
[71] Louis Bagger, "The Army Medical Museum" *Appletons' Journal*, Vol. IX (New York: March 1, 1873): 294.
[72] Ibid. p. 295.
[73] Ibid. 295.

testimonials from foreign doctors about the new supremacy of American medicine. Scientific medicine was now far beyond the reach of the lay person. Orthodox physicians became the leading and often sole authority when it came to the body during the war giving them a status that had hitherto largely eluded them. They decided which cases were interesting, which specimens were worthy of being displayed in the museum and even which bodies should be autopsied. In other words, physicians determined which bodies were useful; and these "chosen" bodies became the most important part of their war narrative. Perhaps more importantly, it was the allopaths alone that profited from these developments and this turn of events helped cement their ascendency over competing sects in the post war period.

Collecting Specimens:

So far this study has suggested that one of the central goals of both the medical department and individual physician was to expand medical knowledge through investigative medicine which would benefit the troops fighting to preserve the Union. The physician John Hill Brinton, Curator of the Surgical Section of the Museum, observed however, that at first "it was no easy matter to popularize the surrender to the Surgeon General's Office of human specimens"; however when "medical officers in the field and hospital felt that the medical department was really in earnest, that a great work was in progress, the objects of the highest interest to military surgery and the wounded of future wars were in contemplation, was the work of preservation efficiently carried on."[74] John Shaw Billings similarly observed that the Army Medical Museum was specifically created to "preserve specimens illustrative of the wounds and diseases which cause death and disability in war, and thereby facilitate the study of methods to diminish mortality and suffering among soldiers."[75]This was a central objective, articulated often which helped garner support for the developing research goals and medical practice during the war. The Army Medical Museum was often referred to as a research center of "national importance" for the "systematic study of the diseases and injuries of soldiers" which were represented by "catalogues, specimens, photographs and a full set of publications on

[74] John H. Brinton Manuscript Collection, OHA RG 124. "Address to the Members of the Graduating Class of the Army Medical Museum" (NMHM)
[75] Quoted in Lamb, p. 4.

medical and surgical subjects."[76]The overall project was for the benefit of soldiers; but in the general descriptions of the Museum the identities of individual soldiers and even the rights of individual soldiers were subordinated to the greater good. It was often observed that "the collection of books, specimens, records constituting the Army Medical Museum and library are of national importance...the contents of the Army Medical Museum and library are unique in completeness with which both military surgeries and the diseases of armies are illustrated."[77]Bodies were not lost in vain if their contribution could be perceived as valuable. After the war the *Medical Record of New York* observed that in addition to the unprecedented cooperation between military and civil physicians, the Museum contained "a collection of scientific treasures that promises speedily to become, if not indeed already, more interesting and valuable than any of its kind in the world."[78] Even one body allowed for the development of scientific medicine in America.

Framing the individual body as useful for the entire army or even country was not uncommon during the war. Robert Alotta examines the court martial system during the Civil War and its effects on individual soldiers.[79]Minor offenders were ordered to pay a fine or ride the wooden horse or some other degrading punishments, or were sentenced to hard labor in the heavy stockades.[80]The worst cases went before a judge and often received a death sentence. There were 275 union soldiers listed as executed during the war; those found guilty of a crime against military or civilian authority were often sentenced to death by a firing squad or hanging.[81] Most of the executions were the result of desertion. Although the desertion total has been listed at more than 200,000 soldiers and 80,000 were caught, only 0.19 percent of those apprehended[82] were executed for desertion.[83]Alotta suggests that "such a small number of men brought to justice indicates a desire—not to fulfill the mandates of military justice—to set an example of some, but

[76]"Library of the Surgeon General's Office: Data relevant to the Library in the Annual Report's of the Surgeon General's Office" National Library of Medicine MS C 185, Box Three.
[77] Ibid.
[78] *The Medical Record of New York*, April 1, 1871.
[79] See, Robert I. Alotta, *Civil War Justice: Union Army Executions Under Lincoln* (Shippensburg, White Mane Publishing Company Inc.: 1989).
[80] The Guns of '62 p. 250.
[81] Hanging was usually assigned to men found guilty of rape, pillaging and robbery. The firing squad was used for deserters, murders and mutineers. Alotta, p. 37.
[82] There was usually a $5 dollar reward for the capture of a deserted soldier.
[83] Alotta, p. 188.

not others."[84]Troops would witness the hanging and also the grave, which was usually dug beforehand and situated directly beside the gallows.[85]In the military, it was perceived as necessary to subordinate individual rights to the collective good. For example, Special Order No. 106, Department of the Gulf, issued on May 2, 1863 stated that: "It has become necessary to prevent demoralization that the fate of this wretched man should be measured out to all who follow his example."[86]The soldier in question was Private Henry Hamill of the New York Infantry, who had confessed to "plundering and pillaging" and was shot to death in front of his unit on April 26, 1863.[87]

In a similar fashion, as doctors began building the national cabinet, soldiers were asked to contribute their bones and specimens for the "good of the country." Brinton recalled a story in which he had to convince a group of soldiers:

> I was informed of a remarkable injury of a lower extremity. The man had died with the limb on and had been carefully buried by his comrades. For some reason or other that specimen was worth having, but his comrades had announced their determination to prevent the doctors from having it. So I visited his mess mates, explained my object, dwelt upon the glory of a patriot giving *part* of his body at least under the special guard of his country, spoke of the desire of the Surgeon General to have that bone. My arguments were conclusive; the comrades of the dead soldier solemnly decided that I should have the bone for the good of the country, and in a body they marched out and dug up the body.[88]

Brinton was fascinated with death[89] and the body and also the development of scientific medicine. He had already begun a private collection of bone specimens, which he had accumulated in the West and added to his personal collection of gunshot wounds of bone[90] but he was thrilled with the prospect of helping the build a national cabinet:

> My whole heart was in the Museum, and I felt that if the medical officers in the field, and those in charge of hospitals, could only be fairly interested, its growth would be rapid, and the future good of such a Grand National Cabinet would be immense. By it the

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[84] Ibid. Alotta found that 54.31 were either foreign born or black and based on the numbers it is apparent that "ethnic and racial factors did influence who was chosen to set the example-by execution." P. 187.

[85] The Guns of '62 p. 252.

[86] Quoted in Alotta, p. 67.

[87] Ibid.

[88] Brinton, *Memoirs*, p. 191.

[89] During his investigations at Antietam he studied "battlefield rigidity" the "instantaneous rigor of death" and published his observations in Hay's *American Journal of the Medical Sciences* (January, 1870): 87. His observations were also reprinted in European Medical Journals. See, *Personal Memoirs of John Brinton: Civil War Surgeon 1861-1865* in eds. John Y. Simon and John S. Haller (Carbondale: Southern Illinois University Press, 1996) p. 207.

[90] *Brinton, Memoirs*, p. 181.

results of the surgery in this war would be preserved for all time, and the education of future generations of military surgeons would be greatly assisted.[91]

Two things were clear from the inception of the project. Firstly, building and contributing to the cabinet was viewed and presented as a special mission and an important educational opportunity. Second, the medical department framed their research and projects around military bodies and body parts, thereby linking bodies with the development of scientific medicine, which legitimated both the work of the museum and its overall usefulness for physicians. In other words, the dead soldiers could save the living. The relationship between the quick and the dead was an important one during the war. As, Michel Foucault suggests, "when death became the concrete a priori of medical experience…it could detach itself from counter-nature and become *embodied* in the *living bodies* of individuals."[92] Arrangements were also made to "inaugurate a system of exchanges" with the museum of the Royal College of Surgeons in London, the Society for Medical Improvement in Boston, The Pathological Societies of San Francisco, Philadelphia, New York, the Smithsonian Institution and various repositories in Germany and Paris.[93] Physicians in the nineteenth-century often judged the scientific value of medical institutions by the medical museums attached to them. As physician Henry Smith observed in 1855, "In the elegant museums attached to their institutions, London surpasses both Paris and the United States."[94]

The unprecedented access to bodies during the war enabled American doctors to become part of nineteenth-century medical culture in a significant way and also opened the way for entrance into the medical elite, which in the third quarter of the nineteenth century was associated with knowledge of bodies and specimens. The experts charged with interpreting how disease functioned within these specimens gave physicians status based on their knowledge of the increasingly complex medical sciences. When George Otis wrote Professor Flowers, Curator of the Museum of the Royal College of Surgeons in London, in reference to an exchange between the two repositories, he assumed a new professional authority grounded in his wartime acquisition of anatomical specimens:

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[91] Ibid.
[92] Michel Foucault, *Birth of the Clinic*, p. 196.
[93] Lamb, p. 36. See also chapter 2.
[94] Quoted in John Harley Warner, *Against the Sprit of the System*, p. 67.

> At present our collection includes thirty five hundred specimens in the surgical series, five hundred in the medical series, one hundred and fifty plaster casts and models, one hundred drawings and paintings and eleven hundred microscopial preparations. In the surgical series illustrations of gunshot injuries predominate; but many of them are of exceeding interest, and they are accompanied by not a few illustrations of surgical diseases of much value. In the medical series, the intestinal lesions of camp fever and dysentery, the great causes of mortality in our armies are largely represented. Duplicates of many of these specimens have been prepared, and we are now engaged in photographing the choicest of them. I propose to send you a series of these photographs, and am authorized to offer to exchange with you a series of illustrations of gunshot injuries, one for each important region, and preparations of lesions of the intestinal canal in fever and dysentery together with microscopial slides of the same lesions for duplicates from your collection.[95]

By listing the sheer numbers of specimens, and especially by commenting on the unique nature of some of the acquisitions, he was asserting himself as expert and using the bodies produced by the war to help professionalize the work of American physicians. Flowers responded to Otis that the council of his college would be "pleased to donate all of the catalogues of their collection—25 printed volumes in total" and in return for "all of the works published by the medical museum, future publications, duplicate specimens (especially if accompanied by a case history)."[96]In the interim he asked for photographs of the specimens. The war produced the objects for the collection, and framing the specimens as important national contributions was a theme that resonated powerfully with the public who flocked to the museum. Otis remarked shortly after the war that "visitors to the museum are so numerous" that he was compelled to extend the hours of opening.[97]Brinton similarly noted that the "the public came to see the bones, attracted by a new sensation."[98]

This study emphasizes the importance of Circular No. 2 for the development of scientific medicine. It permitted the development of a thorough knowledge of human anatomy (learned in a comparative way); its mandates supported an unprecedented skill in dissection and preservation of human bodies; and the collection of specimens and performance of autopsies enabled physicians to study how camp diseases functioned in

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[95] Curatorial Records/ Annual Reports, OHA RG 2 (NMHM) Letter from George Otis to Professor Flowers, November 14, 1864. Flowers had previously been exchanging specimens with Professor Baird of the Smithsonian and Otis comments that the AMM would perhaps have more specimens of particular interest.
[96] Incoming Correspondence, OHA RG 13 (NMHM). Letter from Flowers to Otis Dec. 23, 1864.
[97] Outgoing Correspondence, OHA RG 21 (NMHM) Letter from Otis to Crane Nov. 2, 1869.
[98] Brinton, *Memoirs* p. 189.

the human body. Some physicians published their observations which ensured that their work would legitimate their role as "expert." The core of the project was the collection and study of military bodies, and in order for Circular No. 2 to be effective, it was crucial for physicians to comply with the order. It is important to understand how the national cabinet was built and how the project was framed in order to ensure that the government's ownership of bodies would be largely unchallenged. It was the medical department above all which framed the body as useful for the development of scientific medicine. But there was often tension between the objective of developing scientific medicine and the collection of bodies.

Brinton initially worked with the hospital steward Frederick Schafhert, who had a long history preparing specimens for Joseph Leidy at the University of Pennsylvania and was "adept in preparing and mounting specimens for a museum."[99] The first preparations were less about scientific medicine than establishing ownership of all military bodies. Brinton recalled the story of a soldier who visited the museum to demand the return of his limb and was immediately informed that "the member in question could not be given up" to which the solider replied "but it is mine, part of myself" "earnestly enforcing his claim, which to the lay mind seemed reasonable."[100]"Yet," Brinton continued, "to surrender a specimen was very much like yielding a principle."[101]Indeed, when Hammond gave Brinton his official orders regarding the museum he was explicit that, "should any medical officer of the Army decline or neglect to furnish such preparations for the Museum, you will report the name of such officer to this office."[102]The state and the medical department claimed ownership of military bodies and used this claim to justify dissections that had been considered unacceptable in antebellum America. Brinton's wording regarding ownership is revealing:

> A soldier, a private, came examined the museum, and with the help of the Assistant Curator, found his amputated limb. It seemed to him his own property and he demanded it noisily and pertinaciously. He was silenced only by the question of the curator, "For how long did you enlist, for three years of the war? The United States Government is entitled to all of you until the expiration of the specified time. I dare not give a part of you up before. In the meantime one detachment of you is stationed at the

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[99] Brinton, *Memoirs*, p. 182.
[100] John H. Brinton Manuscript Collection, OHA RG 124. "Address to the Members of the Graduating Class of the Army Medical Museum." (NMHM)
[101] Ibid.
[102] Brinton, *Memoirs*, p. 182.

museum on government duty, the other wherever you may be ordered. Such is the opinion of the attorney general.[103]

Specimens were collected in two ways. The first was Circular No. 2, which required physicians to prepare and submit medical and surgical specimens of interest; almost immediately the greatest interest had been "exhibited by the medical staff in the undertaking and pathological specimens have been continuously forwarded to the museum from every quarter."[104]Doctors were authorized to buy fluids and chemicals to prepare specimens and were further authorized to make requisitions to the medical purveyors for such articles.[105]The second was by charging specific medical officers with collecting, preparing and sending specimens to the museum from the cities in which they were stationed.[106] By order of Hammond, Brinton retained the services of the physician W.W. Keen in the fall of 1862 to "take charge of all such specimens as may be sent to you by the surgeons in charge of the US military hospitals"; he further instructed that "as these specimens accumulate you will forward them in securely fastened barrels to the offices of the Surgeon General at Washington DC."[107]He similarly wrote to Surgeon William Moss[108] who was ordered to proceed to Nashville and consult with Surgeon T.L. Towne to "make suitable arrangements for the preservation and forwarding of pathological specimens."[109]He was then ordered to make arrangements to procure all specimens from Murfreesboro, Louisville and Cincinnati to "make suitable provision for the interests of the museum."[110]Moss was given full authority to order whiskey and barrels and anything else he required for the preservation of medical and surgical specimens.

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[103] Ibid. p. 190.
[104] RG 112 (NARA) Office of the Surgeon General Letters Received 1818-1870, Entry 12. Letter from John Brinton to Joseph Barnes May 14, 1864.
[105] Ibid. Letters sent Feb. 11, 1863.
[106] Surgeons Lavington Quick, Edward Hartshorne, George Shrady, Middleton Goldsmith, F.J. Carpenter, F.L. Towne, John Hodgen, H.S. Hewitt, W.W. Keen were authorized to collect specimens. Lamb, p. 13. In giving these physicians this task, it was presented as a promotion and conferred a measure of status for the physician. As evidenced in the individual physician records it is clear that the physicians above relished the opportunity of this new project. Please see, RG 94 (NARA) Personal Papers of Medical Officers and Physicians, Entry 561.
[107] Outgoing Correspondence Brinton-Otis Letterbook One, Series 5. OHA RG 15 (NMHM) Letter from Brinton to Keen Sept. 25, 1862.
[108] Moss became the first "assistant curator" to the museum, and then a curator charged with working on the specimens. See Brinton, *Memoirs*, p. 185.
[109] Outgoing Correspondence Brinton-Otis Letterbook One, Series 5. OHA RG 15 (NMHM) Letter from Brinton to William Moss Jan. 5, 1863.
[110] Ibid.

After being assigned his task, Brinton was almost draconian in his method; but there was a remarkable openness about the project, which was associated with the increasing professionalization of American physicians. Brinton and his assistants searched for specimens, which had accumulated after each battle in each division, and corps hospitals.[111] He also issued official letters to all heads of the hospitals requesting that any specimens retained since the outset of the war be forwarded "at once" to the museum.[112] Surgeons received instructions on how to prepare specimens:

> In every case of amputation, resection in surgical operations occurring in hospitals affording such specimens to have the soft parts roughly removed from the preparation. You will then send an orderly to the dead house at the barracks hospital directed to the care of surgeon Keen who will take the proper steps to ensure its preservation. Each preparation should be marked by one or two strings, a strap of leather so that it can be compared with the history furnished by you in your report.[113]

There was some urgency in the quest. Even prestigious volunteer physicians such as Drs. Hodgen, Perrin, Bartholow, Hartshorne, Gross and Leidy of Philadelphia received orders demanding the submission of their specimens.[114] Other eminent physicians such as Drs. Letterman, Armory, Simons, Sumner, Lackey, Culpepper, Franklin and Mott were asked to cooperate to help ensure that others would follow suit. [115] When specimens were received at the museum they were carefully compared with official hospital records to ensure that all of the "interesting" ones had been sent. Brinton wrote on one occasion:

> I have the honor to acknowledge the receipt of the pathological specimens forwarded by you from St. Louis to the Army Medical Museum. I did not notice among the preparations already sent of a gunshot wound of the ear which occurred at Fort Donelson, and was treated in the hospital under your charge. The Surgeon General has directed me to request that it be forwarded and also the round ball which inflicted the injury should it be in your possession.[116]

In his quest for specimens, Brinton also monitored hospitals after major battles. For example, he wrote to Surgeon D.P. Smith at the Fairfax Seminary Hospital in Alexandria, Virginia regarding the large number of wounded men after the battle of Fredericksburg.

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[111] John H. Brinton Manuscript Collection, OHA RG 124. "Address to the Members of the Graduating Class of the Army Medical Museum." (NMHM)

[112] Outgoing Correspondence Brinton-Otis Letterbook One, Series 5. OHA RG 15 (NMHM) Letters were dated Oct. 11, 1862.

[113] Ibid. Letters sent to heads of general hospitals Sept. 25, 1862.

[114] Ibid. Letters were dated July 28, 1862.

[115] Ibid. Letters were dated August 7, 1862.

[116] Ibid. Letter from Brinton, Dec. 1, 1862.

He reminded the doctor of his responsibility to comply with the provisions of Circular No. 2 and directed that "all cases of amputation, resection etc. be preserved for the museum." He further reminded Smith that the first catalogue was to be published January 1, 1863 and that he "had better send us all specimens collected by the 28th of this month."[117]Sometimes those collecting the specimens and bodies were welcomed to the battle site. After the Battle of Chancellorsville, perhaps the site of General Lee's greatest victory, Surgeon L. Guild was dispatched to collect Union bodies. Nearly a thousand had died and more than 1500 were injured; permission was granted for a pontoon to cross the United States ford to the Confederate's ambulance train for the internment and removal of the bodies. Guild remarked, "General Lee cheerfully gave his permission for the removal of the dead bodies; remarking that he "did not want a single Yankee to remain on our soil, dead or alive."[118]

Brinton himself collected numerous specimens. He first visited the Washington hospitals and procured "amputated arms and legs," then traveled in the vicinity of the hospital and obtained what he could.[119]These first specimens were cleaned, prepared, mounted and placed throughout the Surgeon General's Office.[120] Eventually the project grew and Brinton moved what he referred to as his "museum possessions" to the museum's first substantial location, Mr. Corcoran's art building, which had been turned over to the medical department for the Army Medical Museum.[121]As the project developed, Brinton aimed to fill the holes in the rapidly developing collection. In what would become a pattern of his correspondence, he wrote Assistant Surgeon January in charge of the General Hospital in Newark late in 1862 requesting "brains after postmortems."[122]A month later he wrote Surgeon Dewitt C. Peters requesting specimens of "the heads, lungs, livers and bladders."[123]Assistant Surgeon Alfred Miller who was

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[117] Ibid. Letter from Brinton Dec. 20, 1862.
[118] RG 94 (NARA) File F Entry 624 "Report to the Medical Director from Surgeon L. Guild" May 23, 1863.
[119] He then went to a number of battlefields including Antietam, Fredericksburg and Malvern Hill for the express purpose of collecting specimens. Outgoing Correspondence Brinton-Otis Letterbook One, Series 5. OHA RG 15 (NMHM) Letter from Brinton to Dr. Schenck Dec. 28, 1862.
[120] Brinton, *Memoirs*, p. 182.
[121] Special Order 116 issued May 22, 1863 granted the use of the school house located in H street north between 13th and 14th owned by Mr. Corcoran for use of the Army Medical Museum Brinton, p.183.Please see appendix three for the homes of the medical museum (currently located in the Armed Forces Institute of Pathology.)
[122] Outgoing Correspondence Brinton-Otis Letterbook One, Series 5. OHA RG 15 (NMHM) Letter from Brinton to January, Dec. 28, 1862.
[123] Ibid. Letter from Brinton to Dewitt C. Peters, Baltimore General Hospital Jan. 5, 1863.

stationed at Fort Ridgely, Minnesota often submitted arrows and Indian bows to the museum. Brinton wrote Miller to inquire as to whether it would be possible for him to "obtain a specimen or so of scalps."[124]The physician J.T. Calhoun suggested to Brinton that it might be prudent to provide each medicine wagon with "a metal can, with a wide mouth and a screw top to hold a gallon each and to contain spirits when furnished." He observed that "this would give every medical officer an opportunity to preserve his specimens…I call to your attention this suggestion as I am convinced if adopted it would secure the museum hundreds specimens. There could have been hundreds more from Wapping and Gettysburg if these cans were furnished."[125]

Occasionally, to Brinton's chagrin he would receive specimens without proper records. For example, Dr. John Liddell, Assistant Surgeon, Stanton General Hospital submitted "an interesting specimen of gangrene of the marrow of the femur," which was obtained at the autopsy of a patient named George Curtis who suffered an amputation of the thigh on June 5, 1864. Liddell asked Brinton to "have it figured out" since "at present we have so much to do with the living we cannot pay much attention to the pathological anatomy as we wish to."[126]In a similar case, the physician H.K. Neff wrote Brinton from the Post Hospital, Morris Island S.C. in September 1863 that he was thrilled to be "assisting Dr. Gross in his amputations" and offered to "furnish any number of recent ones; both flesh and bones" but went on to suggest that "this is a god forsaken place to get anything prepared and are useless unless attended to at once, they become so offensive that we have to dispose of them."[127]But physicians were also reprimanded and even accused of hindering the development of the profession or even medical knowledge by not sending their specimens. As one physician was told:

> The Surgeon General directs me to inform you that it has been reported to this office that you refused to save a specimen of a wounded leg of a soldier under your care when properly asked by Dr. Hartshorne, AA Surgeon USA. The Surgeon General further directs me to say that it is his intention to avail himself of the sad opportunity presented by this war to establish a military pathological cabinet of specimens collected from every military hospital, and to carry out his intention, he has directed that all medical officers in

[124] Ibid. Letter sent from Brinton Dec. 22, 1862.
[125] RG 94 (NARA) Reports of Diseases and Individual Cases 1841-1893 File A, Entry 336. "History of Five Specimens Forwarded to the AMM with Suggestions as to the Preservations of Specimens in Field Service." Submitted to Brinton from J.T Calhoun.
[126] RG 94 (NARA) Medical Records 1814-1919, D File Box 14. Report from John Lidell to John Brinton June 8, 1864.
[127] Outgoing Correspondence Brinton-Otis Letterbook One, Series 5. OHA RG 15 (NMHM) Letter from H.K. Neff to Brinton Sept. 24, 1863.

charge of military hospitals of soldiers sick and wounded, shall preserve all pathological specimens which in their opinion might serve to enrich such a collection. He hears with regret that any member of our liberal profession should neglect or refuse to cooperate in so laudable an endeavor to promote scientific knowledge …he should deem it to be his duty to close any official connection that might exist between yourself and the United States.[128]

Other difficulties with the project included occasional contests over specimens as the government asserted ownership of all military bodies. S.W. Gross of Davis Island General Hospital became involved in a controversy when the man who had charge of his dead house "stole the specimens and sold them to Dr. James R. Wood of New York."[129] The man in question had "prepared himself after learning at military hospitals in Washington and then on Davis Island" and was "intelligent and had a keen interest in the preparation of pathological specimens."[130]Medical Director Charles McDougall was requested to procure Wood's specimens for "transmission to the Army Medical Museum for which they were originally intended." The museum was intended to appeal to the medical profession's desire for improvement and respectability. McDougall warned Wood that it is the "wish and intention of the Surgeon General to preserve for this Museum every object which contributes hereafter to throw light on medical science."[131] On February 24 McDougall wrote to tell Brinton that the stolen specimens from Davis Island had been recovered and would be forwarded "with as little delay as possible."[132]

While this conflict was easily resolved some were not. The physician Reed Bontecou and the Surgeon General's Office were involved in a prolonged struggle over bodies. In early 1863, Hammond wrote Bontecou in regard to "two to three hundred pathological specimens" which Bontecou had obtained while in charge of the Hygeia Hospital. He was asked to answer the charge that he had stolen the specimens. Bontecou immediately denied it but protested that he had, during the months of April, May, June and July, 1862 collected "bone specimens to the number of 70-80 and wet preparations to the number of 30, which I presumed belonged to whoever collected them, at that time not

[128] RG 112 (NARA) Records of the Office of the Surgeon General Central Office Correspondence, 1818-1946. Letters and Endorsements. Entry 2. To Dr. R.S. Kenderdine, Philadelphia from the Surgeon General's Office, August 25, 1862
[129] Outgoing Correspondence Brinton-Otis Letterbook One, Series 5. Letter from Charles McDougall to S.W. Gross Feb. 23, 1863 copied to Brinton.(NMHM)
[130] Ibid.
[131] Ibid.
[132] Incoming Correspondence OHA, RG 13.To Hammond from Charles McDougall Feb. 24, 1863. (NMHM)

having heard or seen any order to the contrary."[133]He then claimed that the wet preparations were "accidentally destroyed by the negroes who cleared the dead house."[134] The bone specimens he gave to Professor Thomas Markoe of New York, who worked as a volunteer in the hospital. And the "interesting specimen" that Hammond requested (a femur) had been given to R.H. Gilbert, the surgeon in charge of the Post Hospital at Fort Monroe, who had "ably assisted" Bontecou for a few days. Bontecou promised to comply with the mandates of Circular No. 2 thereafter and said that he would soon submit the "good collection" he already had.[135]Apparently this was not sufficient for Brinton and Hammond who continued searching for the missing specimens. Brinton submitted a report to Hammond in June of 1863 and was clearly irritated that Bontecou had given away specimens that "did not belong to him, but were then the property of the medical department." Brinton further suspected Bontecou was still collecting specimens after Circular No. 2 and suggested that Hammond insist on them for the museum "as they were its property," particularly since Bontecou seems to have been "directly violating the Surgeon General's orders."[136]The following week Brinton wrote Markoe:

> I am directed by the Surgeon General to make to you relative to certain specimens of morbid anatomy collected by Surgeon R. Bontecou, and which **properly belong** to the Army Medical Museum. Surgeon Bontecou states that when on duty in the Peninsula, he had collected numerous pathological specimens and that in his ignorance of the requirements of the service, he had given between seventy and eighty of these preparations to you. By the regulations of the department all specimens collected by medical officers **belong to the national museum; no other disposition of these objects is permitted.**[137]

Markoe was ordered to return all of the specimens to Medical Director Charles McDougall which had been transferred to him by Bontecou "under the mistaken impression that he possessed the right to part with them."[138]The language of these letters

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[133] Ibid. From Hammond to Bontecou copied to Brinton Feb. 23, 1863.
[134] Like Gross, he blames the destruction or loss of specimens on "negroes" in charge of the dead house—but considering Bontecou's numerous publications, many of which relied on wet specimens, I think this is probably unlikely. See, RG 94 (NARA) Records of the Adjunct General's Office, Records of the Record and Pension Office-Medical Records: Reports of Diseases and Individual Cases 1841-93. File A and Bound Manuscripts Entry 621, for Bontecou's case book.
[135] Ibid. From Hammond to Bontecou copied to Brinton Feb. 23, 1863. He eventually submitted 101 specimens.
[136] Curatorial Records, Circulars and Reports OHA RG 6 Box One. Report by Brinton to Hammond June 2, 1863. (NMHM)
[137] Outgoing Correspondence Brinton-Otis Letterbook One, Series 5. OHA RG 15 Letter from Brinton to Thomas Markoe. March 4, 1863. (NMHM)
[138] Ibid.

reveals the government's determination to have all specimens and the doctors' compliance. Markoe responded that he would "of course give up the specimens" which he was satisfied were government property.[139]He did, however, suggest that he had some "doubt of the fact" that the specimens prior to Circular No.2 belonged to the Surgeon General. He therefore requested to be allowed to keep "several whole heads not exhibiting gunshot wounds," about which he wanted to write a paper for the *Medical and Surgical History*.[140]Physicians often attempted to hold onto the specimens they had collected prior to Circular No. 2. Dr. James Armsby, for example, had in his private collection photographs of a few interesting cases, which he was accused of not submitting to the museum. He made a sworn statement to Brinton that the photographs in question "were taken while in private practice before entry into the service" and that he had "transmitted every specimen to the Army Medical Museum that he had obtained in the Ira Harris Hospital."[141] Brinton wrote to the physician J.W. Mintzer that "it was reported to this office recently that there was in your possession a half barrel containing a large number of pathological specimens for the AMM. They must be forwarded to this office immediately."[142]

Physicians clearly coveted this unprecedented access to bodies. Dr. Alexander Hoff volunteered to serve in the spring of 1861and was soon appointed surgeon of the Third New York Volunteers. He often wrote his mentor Alden March from his post aboard the US Hospital Steamer, the *DA January*, about his experiences. He noted early in the war that he was "expecting another load of sick and wounded and should I have any interesting cases I will send you drawings and as much information as I can get."[143] One particularly revealing letter told March about some of the amputations he witnessed:

> I saw a surgeon in the battlefield standing by his operating table, covered with blood, with a pile of legs and arms around him… I thought surgery consisted of anything but mutilation. Sure enough stretcher after stretcher brought more wounded, ready to add an arm or a leg to the pile…you would have been amused when it was suggested that some of these limbs might be saved, at the ferocious expression of this operator! And

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[139] Outgoing Correspondence Brinton-Otis Letterbook One, Series 5. OHA RG 15 Letter from Thomas Markoe to Brinton May 27, 1863. (NMHM)
[140] Ibid.
[141] Ibid. To Brinton from James Armsby Dec. 21, 1865.
[142] Outgoing Correspondence Brinton-Otis Letterbook One, Series 5. OHA RG 15 From Brinton to J.W. Mintzer June 6, 1863. (NMHM)
[143] Alexander Henry Hoff Papers, 1821-1876, MS C 484, (National Library of Medicine, Bethesda MD) Letter from Alexander Hoff to Professor Alden March- Dec. 20, 1862

when calm persuasion failed to arrest what is considered butchery and a preemptory stayed proceedings the knife was thrown down and a quick movement but not without its difficulty brought the angry surgeon outside of his barricade of arms and legs, and a consulting board began to find plenty to save but few to mutilate. The man seemed to believe that cutting off so many arms and legs in one day constituted his greatness.[144]

Hoff also took advantage of the bodies that the war produced, telling March:

I am gathering for you some specimens of missiles, and will send to you by express some six balls with description when an opportunity presents. I will forward a shell, conoidal cannon ball and also some specimens caused by some of them as soon as I can collect them. The Surgeon General demands everything in that line, but I have made up my mind to put aside a few for the very next opportunity.[145]

Dr. J.E. Ebersole of the 19th Indiana Volunteers similarly appropriated a number of pathological specimens after Gettysburg for his private collection. He too was sent a letter by Hammond reminding him that "all specimens occurring in the Army Hospitals are the property of the Army Medical Museum and must be forwarded by the Adams Express Company to the museum immediately."[146]The physician George B. Cogwell likewise received a letter on June 5, 1863 in which Brinton stated:

It has been reported to this office that there is in your possession an exceedingly valuable pathological preparation which was obtained at the hospital in the barn of Philip Ray near Keedysville after the Battle of Antietam. The specimen alluded to is one of a gunshot fracture of the jaw and humerus, one of the molar teeth having been driven into the head of the latter bone. You had better forward the specimen to this office immediately.[147]

Sometimes physicians claimed that specimens had been stolen and they could not be recovered. The physician H.K. Neff sent a large number of specimens to Washington from Port Royal but left a number at his hotel, which still needed preparation, "in the care of the proprietor"; when he returned they had gone.[148]Stolen specimens were a recurring problem. Dr. J.W. Mintzer wrote to Brinton in June, 1863 informing him that he had recently submitted a "small box of pathological specimens"; he apologized that they were in such bad condition since his assistant had inexplicably "broke open the barrel

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[144] Ibid. Letter from Alex Hoff to Professor Alden March October 9, 1863, From Memphis Tennessee.
[145] Ibid.
[146]Outgoing Correspondence Brinton-Otis Letterbook One, Series 5. OHA RG 15 Letter from Hammond to J.E. Ebersole July 26, 1863. (NMHM)
[147] Ibid. Letter from Brinton to George Cogwell, June 5, 1863.
[148] Incoming Correspondence Otis Historical Archives, RG 13 Letter from H.K. Neff, Huntington Penn. To Brinton, June 21, 1864. (NMHM)

containing the specimens and its contents were buried."[149]His assistant, Mr. Dowling was charged with "exhuming the buried specimens" and a further search was instituted. Minzter did, however, assure Brinton that he was busy preparing more specimens in his leisure and would be "happy to deliver them in person."[150]

The medical profession's enthusiasm for anatomy was not without its critics. Sometimes friends would wait by the side of the patient so they could immediately take the body home. For example, Martin Karr a Private from Co. H 1st New York Volunteers, had been wounded by a shell in the right knee joint and had an amputation by double flaps in the field.[151] He was later admitted to Douglas Hospital and treated by Dr. William Thomson. His case file noted that during transport to the hospital his wound had become infected with what was likely pyemia. While Thomson was sure, based on the patient's symptoms, that this was what he was suffering from, "the body was not autopsied owing to the desire of his friends to remove him without delay."[152]The friends did, however, allow Thomson to remove the femur from the stump, and he was thus able to "saw the leg longitudinally," which exposed the "decomposed condition of the medulla" as "constantly observed in this disease."[153]Though most of this soldier's remains were claimed by the family, the femur was submitted to the Medical Museum, illustrating both the cooperation and the tension between physicians and the public. Some case reports simply give details up to death and then stated "autopsy not permitted."[154]In the case of Phineas Brown who died of tetanus in August, 1864 at the Albany State Hospital, the attending physician Mason J. Cogswell remarked in the report: "as his friends were momentarily expected, the patient's residence being only seven miles from this city, no general post mortem was made."[155]Similarly, Assistant Surgeon H. Stone remarked after treating a patient who succumbed to pyemia after the Battle of Antietam: "no specimen

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149 Incoming Correspondence Otis Historical Archives, RG 13. Letter from J.W. Mintzer to Brinton June 9, 1863. (NMHM)
150 Ibid.
151 RG 94 (NARA) Medical Records 1814-1919, D File Box 28 "Specimen Histories" Histories of Pathological Specimens, prepared and forwarded by William Thomson from Douglas Hospital.
152 Ibid.
153 Ibid.
154 These occur only infrequently and can be found in case histories largely in RG 94 (NARA) File A and D.
155 RG 94 (NARA) Records of the Adjunct General's Office, Records of the Record and Pension Office-Medical Records: Reports of Diseases and Individual Cases 1841-93. File A and Bound Manuscripts Entry 621, Box Four "Remarks on the Monthly Report of Sick and Wounded in US General Hospital in Albany State, New York August 1864" Submitted by Mason Cogswell, Assistant Surgeon U.S. Volunteers.

was sent because an autopsy could not be made as the body of the patient was taken home by his friends."[156] That they do not go into detail suggests that it was understood that members of the family had prior claim to the body and could take it away. In comparison to the number of autopsies, however, family claims to the body were fairly rare.

If the specimen could be used, it gave meaning to the soldier's life. Contribution of a body or body part to the development of the national cabinet represented the final sacrifice to showcase the commitment to the country. Assistant Surgeon J.T. Calhoun, sent a number of specimens from the Battle of Wapping Heights, July 23, 1863[157] and observed that he had "collected them off the field more due to the gallant action of Wapping Heights to be represented at the AMM then their value as pathological specimens."[158] Indeed, Brinton observed that while at first there was some "natural aversion on the part of the wounded soldiers and their friends" and that the "topic was a ghastly one" soldiers did often comply with the request for their specimens:

> I recollect one instance of a very rare and carefully studied case of a leg injury. The patient died and was buried in soldier fashion. His bosom friends sat up and watched as the nefarious collector came. So great was his earnestness, so deep his sympathy, so moving his eloquence, so unanswerable his argument that patriotic bones rest better in government cases than in a Virginia trench, that the stony hearts of the watchers were softened. Slowly and mournfully the former comrades marched to the burial spot. The leg was exhumed, the bone taken out and carefully inspected by the mourners, the chief of whom remarked "after all John would rather be of some use to the very end.[159]

The idea of useful limbs sometimes appealed to a soldier who would on occasion request to see his contribution to the making of the National Cabinet. These men were surprisingly deferential to the staff at the museum. Former Union Solider Lorin Leray, for example, wrote the museum Dec. 29, 1883 inquiring after his limb:

> Dear Sir: Nineteen years ago, Surgeon A.J. Bartlett 33rd Minn, now of Illinois, removed the head of the humerus from my left arm. He writes me that he sent the bone with a minie ball sticking in it to the Army Medical Museum at Washington—it is numbered 6599 in the surgical section. I have never seen the piece removed. Will you

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[156] RG 94 (NARA)) Medical Records 1814-1919 D File, Entry 147 "Case of Pyemia subsequent to an operation of resection of the radius after being wounded Sept. 17, 1862 at Antietam" Submitted by Assistant Surgeon H. Stone.
[157] Also known as the Battle of Manassas Gap.
[158] RG 94 (NARA) Records of the Adjunct General's Office, Records of the Record and Pension Office-Medical Records: Reports of Diseases and Individual Cases 1841-93. File A and Bound Manuscripts. Entry 336. "History of Five Specimens Forwarded to the AMM with Suggestions as to the Preservations of Specimens in Field Service." Submitted to Brinton from J.T Calhoun.
[159] John H. Brinton Manuscript Collection, OHA RG 124. "Address to the Members of the Graduating Class of the Army Medical Museum" (NMHM)

kindly have the bone with the ball in it photographed and sent to me? I will be glad to incur all the necessary expense. I hope you will do this as it will be a valuable war relic to me.[160]

There seemed to be pride associated with having a specimen preserved and displayed in the national museum since letters like Lorin Leray's were quite common. Soldiers often wrote, not asking for the actual specimen but rather photographs of it.[161]One visitor to the museum observed:

> The fact of having a portion of one's body put on exhibition here before the wondering gaze of casual visitors and critical scrutiny of medical students, seems however, not to affect some of the "subjects" who have contributed the "bone of their bone and the flesh of their flesh" to the museum. One of the orderlies attached to the museum is *minus* the bone of the right arm, from the shoulder blade to the elbow; but he has the satisfaction-if satisfaction it is-to be able to go and take a look at it every day.[162]

This pride was perhaps exemplified best by Major General Daniel Sickles, who had received an amputation in the lowest third of the thigh on the field at Gettysburg July 2, 1863.[163]Surgeon T. Sim, U.S. Volunteers, mailed the amputated leg to the museum in a small coffin with his calling card saying "from the compliments of General Sickles." Woodward later suggested that after Sickles recovered from the shock of the operation his first thought was "of the museum at Washington, to which he ordered the broken bone sent, in the hope that his misfortune might prove the gain of fellow soldiers in the future."[164]It is very significant and revealing of the public's general acceptance of the new AMM that Woodward outlined in detail a complete list of the museum's collection (medical, surgical, anatomical and microscopial preparations compiled from the human material of American soldiers) in the popular *Lippincotts Magazine* rather than a medical journal. He cleverly linked the bodies, the on-going work and the anatomical displays with the advancement of medical science. There was generally only moderate opposition

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160 Incoming Correspondence, Otis Historical Archives, RG 13 (NMHM) Letter from Lorin Leray, Dec. 29, 1883.
161 Soldiers often wrote the museum and gave the number of their specimens or history of the wound, along with photographs of themselves, which often illustrated the missing part in question; they then asked for a photograph of the specimen. The tone of the letters were often friendly, deferential not demanding as I thought they might have been. See, RG 13 Otis Historical Archives,Incoming Correspondence. Most letters came in the 1870s and 1880s. The pension records at NARA and the Searcher Reports at the NMHM also contain these types of letters. In some cases it was to show their entitlement to a pension.
162 Bagger, p. 296.
163 For an interesting history on Sickles please see, James A. Hessler, *Sickles at Gettysburg: The Controversial Civil War General who Committed Murder, Abandoned Little Round Top and Declared Himself the Hero of Gettysburg* (New York: Savas Beatie, 2009)
164 Woodward, Lippincotts p. 236.

to the dissection of bodies during the war because the project was framed in a way that appealed to the public's desire for progress and development. As Woodward noted:

> Under these circumstances it may fairly be regarded as one of the large compensations of human history that the periods of pestilence and war with which our race is scourged from time to time, serve generally to give a fresh impulse to the genius of those who have devoted themselves to medical pursuits, enabling them to make new discoveries, and to accumulate stores of knowledge which serve to increase their usefulness in ordinary times.[165]

George Frederickson demonstrates that both during and after the war there was a "decline in the prestige of traditional religion" (in which opposition to dissection had generally been couched) and a developing interest in new scientific ideas, principally Darwinism.[166]The wartime acquisition of bodies was no longer about pillaging graves in the dead of night; rather there was openness to the project. The public was aware of the many aspects, but in contrast to Jacksonian America in which everyone could theoretically be privy to the same knowledge, the medical profession's new project was beyond the realm of understanding of the lay person. There was a "new elitism based on the organized intellect of a scientific age"[167] from which the orthodox medical profession benefited. The public was aware that the bodies had a practical function, which would benefit all Americans. Although the work of collecting the material of soldiers' was "ghoul-like,"[168]as Brinton himself conceded, the medical department needed the bodies to develop scientific medicine, which had become a central objective during the war.

Body of Knowledge:

The way the project[169]functioned was interesting. The first museum catalogue, published in early January, 1863, was quite small, showing only 1349 objects: 988 surgical, 106 medical and 133 extracted projectiles.[170]Through examining the catalogue, the staff at the Surgeon General's Office could compare incoming case studies, narratives of service, hospital registers and autopsy reports to determine what specific diseases they subsequently wanted to study and illustrate in the National Cabinet. From its very

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[165] Woodward, *Lippincotts* p. 233.
[166] George Frederickson, *The Inner Civil War: Northern Intellectuals and the Crisis of the Union* (New York: Harper and Row, 1965) p. 199.
[167] Frederickson, p. 201.
[168] Brinton, *Memoirs*, p. 187.
[169] As initiated by Circular No. 2.
[170] Brinton, p. 188.

inception, the project was framed as an important educational tool for the benefit of both American physicians and American medicine. The staff at the museum used the specimens to learn about the way disease functioned, to compare case reports and to train physicians. Woodward wrote J.T Cantwell, Assistant Surgeon with the 82nd regiment Ohio Volunteers Mansfield March 12 1864, to thank him for sending the "specimens of gallstone" but recommended reading Thudichum on Gallstones, London "an excellent work full of instruction" which Woodward believed would help Cantwell's understanding.[171]Some cases helped to elucidate the function of specific diseases that had previously been unknown or little understood, encouraging new experiments in the management of disease. As Woodward wrote on one occasion:

> In your letter to the Surgeon General's Office of Oct. 17th you make an observation with regard to the proliferation of the connective tissue of the medulla oblongata and cerebellum in a case of tetanus, which if correct is of such importance that I cannot refrain from expressing the hope that you have preserved microscopial specimens to demonstrate the condition in question, or at least that you have preserved portion of the tissue involved from which of course such preparation could still be readily obtained.[172]

Woodward had long been interested in tetanus[173] and asked Surgeon McGill, who had also been conducting independent experiments on it, to "contribute to the microscopial department of the museum, one or more specimens which may serve to show the nature of this condition."[174]Woodward let the specimens accumulate and then decided which were needed to enhance the collection. After examining the museum's collection immediately after the first catalogue was published, he requested physicians to submit, "all abnormalities or irregularities which will make good wet specimens, all pathological conditions (not surgical strictly) which will do the same, and calculi, parasites etc."[175] He further requested "a good series of specimens illustrating disease of the brain and nervous system, a series on valvular disease of the heart, a series of

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[171] Woodward's Letterbooks OHA RG 28 Woodward to Cantwell, March 12, 1864. (NMHM)
[172] Ibid. Woodward to Surgeon M. McGill Oct. 23, 1866
[173] Indeed, many elite physicians including S.Weir Mitchell, DaCosta and Keen conducted experiments on tetanus (caused from infection, transmitted by animal feces, or contracted during surgery in temporary field hospitals set up near barns—it caused painful muscle spasms, patients could not swallow or breathe, back, abdominal, limb muscles become rigid, extremely painful.) Brown-Sequard spoke at length on tetanus, including post mortem appearances, symptoms, treatment and prevention during his lecture at the Smithsonian. See RG 94 (NARA) File A 344 Entry 621 "Notes of Lecture by Dr. Brown-Sequard Delivered at the Smithsonian Institution June 14, 1864."
[174]Woodward's Letterbooks OHA RG 28 Woodward to Surgeon M. McGill Oct. 23, 1866. (NMHM)
[175] Ibid. Woodward to Charles Greenleaf, Nov. 4, 1864.

tubercles off the lungs, showing different stages, cavities etc., cancers and tumors of internal organs and specimens illustrating enteric fever and chronic diarrhea."[176] Woodward realized the unique opportunity to build a cabinet of "accumulated material such as is often needed for purposes of comparison in arriving at the intelligent interpretation of an individual case."[177]It was a central objective and a unique opportunity to be able to marshal all of the physicians working in the medical department to amass this "wealth of accumulated material." The objectives were continually published to induce physicians to contribute to the project. In May 1863, the *American Medical Times* encouraged "every physician connected with the army or with its hospitals" to "carefully preserve all pathological specimens, and forward them with accurate histories to the Curator. The name of each contributor appears in the catalogue in connection with the specimens."[178] By being linked to the specimens they collected and dissected, physicians could build their careers and reputations from their association with soldiers' body parts.[179]

But how *exactly* did physicians learn from the mandate to collect specimens? There was an interesting relation between intent and realization of objectives. The most pronounced effect of the mandate to collect specimens was that they were encouraged to see beyond the patient with a view to the knowledge that could be derived from the body which changed basic assumptions about how to study medicine and disease. The case reports that accompanied medical and surgical specimens provide excellent insight into what was deemed interesting or important enough to submit to the museum, and the staff at the Army Medical Museum always strove to ensure that physicians engaged with Civil War bodies understood that they must collect specimens in a way that would make them of use for the purposes of science. The case histories that were submitted along with the

[176] Ibid.
[177] Ibid.
[178] *American Medical Times*, Vol. 6 (May 23, 1863): 249.
[179] This project also illustrates the institutional importance of the AMM for the development of scientific medicine in America. Interestingly, the other main institutional body, the Sanitary Commission also had an important institutional function and they used the support of the government to develop preventative medicine (central goal), relief for the soldiers and the organization of medical professionals (administrators, doctors, nurses, volunteers). In terms of the work of individual physicians, there was much overlap between the two organizations. See, *The Sanitary Commission of the United States Army: A Succinct Narrative of its Works and Purposes* (New York: United States Sanitary Commission, 1864). The government support of these institutions, well illustrates the environment in which scientific medicine could develop in America. When I expand this study into a book I would like to add a chapter entitled "The Science of Sanitarianism" and examine the scientific work of the Sanitary Commission.

specimens affirmed the individual physician's commitment to medical science.[180] The specimens, particularly at the beginning, were usually the direct result of disease or wounds. J. Dalton a private from Pennsylvania had been shot at Gettysburg, the ball entering the right side one inch above the crest of the ileum and remaining in the wound. Shortly afterwards he died of his wound. The autopsy documented that "the ball entered the spinal column of the right side at the articulation of the 4th or 5th lumbar vertebrae just in front of their transverse processes destroying the continuity of the spinal canal and facing obliquely upwards through the body of the 4th lodged in that of the 3rd on the left side."[181] The spine was sent to the museum, along with the ball.[182] Similarly, Dr. William Thompson submitted the case history of Coleman Boyer, Co. L 112th PA Volunteers who had been struck by a round ball, which entered the right arm above the elbow joint, escaped at the middle of the arm anteriorly and inflicted another wound in the thumb.[183] Boyer was also inflicted with a back shot in the right opposite side of the 9th dorsal vertebrae and one-inch outside the spinous processes which penetrated the thoracic cavity and then passed through the lower lobe. He soon died of shock and the entire arm was submitted to the museum. Thomson pointed out that "The specimen indicates the amount of injury possible from a round ball when passing through the elbow joint."[184] Cases such as these represent the original function of the museum, which was to learn from the specimens and effectively illustrate the effect of wounds and diseases.

Some cases, however, demanded more comprehensive study. Frank Vogle, Private Co. G 74th Regiment, PA Vols., was wounded at Gettysburg by a minie ball, which entered on the front of the right leg, six inches below the knee joint, passed around the fibula and exited behind the calf of the leg.[185] The case report, submitted by Assistant Surgeon I. Eagleton is more than 12 pages long, because despite treating the wound

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[180] As opposed to the 1840s and 50s, where bodies were stolen and dissected out of mere fascination with the body (by some) with less focus on the overall contribution to the medical sciences.

[181] RG 94 (NARA) Medical Records: Reports of Diseases and Individual Cases 1841-93. File A, Entry 171. History of Pathological Specimens forwarded to the AMM, USA General Hospital Broad and Cherry Street Philadelphia, Penn submitted by William Keating, Assistant Surgeon USA."

[182] Ibid.

[183] RG 94 (NARA) Medical Records: Reports of Diseases and Individual Cases 1841-93. File A, Entry 171 "History of Pathological Specimens prepared and forwarded by William Thompson from Douglas Hospital, 1864"

[184] Ibid.

[185] RG 94 (NARA) Medical Records: Reports of Diseases and Individual Cases 1841-93. History of Pathological Specimens forwarded to the AMM, File A, Entry 171 General Hospital Broad and Cherry Street Philadelphia, Penn submitted by I. Eagleton, Assistant Surgeon USA.

prohylactically with carbolic acid, followed by a fermented poultice, tonic and extra diet, it developed great complications from gangrene which quickly spread.[186]The doctors after consultation decided to amputate below the knee joint, despite the patient's severely weakened state. The patient fared well during and immediately after the operation, which was performed by Assistant Surgeon A. Hewson who was also in residence at the hospital, but within a few days he suffered "an attack of hemorrhage from the stump." The physicians went to great lengths to try to save Vogle, but he eventually died and a post mortem was made within a few hours of his death. Rather than merely focusing on the wound this was aimed at tracing the cause of the hemorrhage:

> The abdomen was opened and on dissecting up the artery from below pouparts ligament, there was found a larger opening in the external iliac artery at the original point of ligation and a recent clot had formed in the artery above—extending to the bifurcation of the primitive iliac. The second ligature a half inch above had alone included the tendon of the psoas magnus, the artery having unfortunately escaped ligation. Yet in the face of the large opening examining the artery for five days after the ligature was applied it was very singular that no hemorrhage should occur and the patient was apparently doing well until the last and fatal hemorrhage took place.[187]

The doctors determined that a clot had formed before the last ligature was applied, thereby filling the opening. They submitted both medical specimens and the original amputated leg to the Museum.[188]

Some of the cases and operations performed were truly remarkable. Assistant surgeon J.T. Calhoun, Medical Director of the 3rd Army Corps performed a very complicated facial reconstruction in the field hospital immediately following the Battle of Gettysburg. Private John Hall, Co. 8' 11th N.Y Vols. had been shot and the shell had torn his cheek, producing a "horrible compound comminuted fracture of the inferior maxillary."[189]The patient was placed under chloroform and Calhoun along with Assistant Surgeons Jameson and Hays also of the 8, 11th N.Y Vols. removed "piece after piece of bone" with a pair of duck billed forceps "suppurating the muscles from the bone." Little hemorrhaging took place and the operation continued. The bone at the chin had been

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[186] Ibid.
[187] Ibid.
[188] Ibid.
[189] RG 94 (NARA) Medical Records: Reports of Diseases and Individual Cases 1841-93. File A, Entry 336. "History of Five Specimens Forwarded to the AMM with Suggestions as to the Preservations of Specimens in Field Service." Submitted to Brinton from J.T Calhoun.

shattered and the "soft parts had to be held in place." During the operation, the tongue was carefully kept in sight and a ligature was passed through its tip and held by Surgeon Hays. After carefully "securing all bleeding vessels and getting rid of all burnt or destroyed tissue, the excessively ragged wound was brought together in accurate opposition by the introduction of silver pins, with a wire figure of 8 suture (instead of thread-a decided improvement since thread makes a sharp quick turn around the pin while the wire makes a graceful curve producing no severe pressure on any one point.)"[190] The dressings were treated with charpie and water and the patient recovered "nicely." Calhoun submitted the superior maxillary bone for display at the AMM along with the case history of the operation.[191]

Asking physicians to preserve interesting or important specimens forced them to think about what part of the body would be valuable in illustrating the wound or disease, which helped develop medical knowledge. The autonomy physicians had in making these decisions was a particularly significant result of this project. As Brinton observed, "the value of all pathological specimens depends to a great extent upon the completeness of their history, strenuous efforts have been made to procure an accurate surgical and medical account of every case from which a specimen has been taken."[192]Brinton articulated this sentiment to many physicians: "it should be reasonably expected of every medical officer of the army that he will have sufficient **professional interest and pride** to keep a correct record of his medical and surgical cases."[193]It was part of the backlash against the laissez faire medical culture in Jacksonian America that physicians were expected to adhere and contribute to the development of these new standards.[194] Directives came from the elite but all physicians could contribute to the development of scientific medicine. In the cases cited, physicians learned valuable lessons about specific aspects of medical practice for example, conservative surgery which William Thomson championed. He was particularly interested in the amputations of the knee joint that affected the popliteal artery, making the amputation very unsafe. He made a number of

[190] Ibid.
[191] Ibid.
[192] Army Medical Museum, Report to the Surgeon General, Washington DC, January 10, 1863. OHA RG 6 (NMHM)
[193] RG 94 (NARA) Medical Records 1814-1919, File D, "Report from Brinton on the Inspection of Books, registrars of the U.S. Hospitals Nov. 21, 1863" submitted to Hammond and medical inspectors, hospitals.
[194] Furthermore, these physicians were lucky to have a hospital post, and they knew it. They also knew that they had to comply with the requests made of them or their hospital position would be in jeopardy.

findings after extensively studying the case of G.W. Perkins, Co. G 1st Massachusetts Cavalry, who was struck by a pistol ball in the left leg at Brandy Station.[195]Thomson suggested to Hammond that this particular case was "of great interest" and could be valuable in teaching physicians in the field as well as benefiting the AMM collection.

On Perkins's admission to Douglas Hospital three days after the injury, it was found that a pistol ball had entered the left knee joint near the outer and inferior margin of the patella, slightly grazed the head of the tibia and escaped near the head of the fibula. A small portion of spongy bone and cartilage was removed from the wound of exit. Thomson confirmed that "the joint was swollen and fluctuated distinctly." After etherizing the patient, Thomson flexed the patient's leg strongly during his examination and a "quantity of dark blood escaped from the wound of exit." Thomson evaluated the wound cognizant of a number of factors:

The man's youth, his robust appearance, his great unwillingness to submit to an amputation, the very slight injury done to the bones, and a strong desire to discuss some alternatives for the unvarying mutilation considered necessary in such cases tempted me to make an effort to save life and limb. I was fully aware that the knee joint was surely involved.[196]

Thomson attempted to save the limb because, as he pointed out to Hammond, he had much experience of treating this type of injury:

From a careful study of a number of cases of gunshot wounds of the knee joint, treated timidly, with simple water dressing I had become convinced that the retention of the products of inflammation in the joint was the prime cause of the enormous abscess in the thigh. The cases that have come under my own notice have, when treated without amputation, followed invariable pathology. The inflammation of the synovial membrane is soon followed by an effusion of serum distending the joint, causing fluctuation and giving rise to tenderness or pressure and pain. There is at that period therefore of swelling and redness. Suddenly this swelling disappears, the outlines of the bones are readily felt, the tension is removed and with it the pain and tenderness. An inexperienced surgeon fancies that the synovitis is yielding to his therapeutics. In a few days the thigh will be found tender and pressure particularly on the inner aspect with slight swelling. The product of inflammation-pus and serum- generated in the joint have found their way into the tissues of the thigh and have there executed an inflammation which will produce most extensive abscess and give rise to unmanageable hectic and cause fatal result; from this the great and exhausting discharge. An amputation performed after the muscles have been

[195] RG 94 (NARA) Medical Records: Reports of Diseases and Individual Cases 1841-93. File A, Entry 103, "Specimen Histories Douglas USA General Hospital for June 1863" submitted by William Thomson.
[196] Ibid.

> dissected from each other and the soft tissues disorganized have been in all cases that I have seen rapidly fatal.[197]

Thomson decided to relieve the pressure and release any serum or pus that might be formed with the joint by making extensive incisions. Prior to the operation, the knee was "irrigated with ice water." Soon, however, the joint became very "tense and swollen" and the patient sick with infection. Thomson treated him with extra diet, tonics and morphine and attempted to relieve the swelling by incising the wound, after which he placed the leg in a fracture box with straw, dressed it with cold water and administering a larger dose of morphine. From June 15 to July 1 the patient was monitored almost hourly and Thomson kept detailed accounts of each visit. But a second hemorrhage took place and could not be arrested by compression on the artery of the groin and the patient died.

The autopsy was made three hours later by Thomson who found "a diffused abscess in the popliteal space, following the artery as far as hunting canal but not involving tissues of the thigh." He attributed the hemorrhage to a "very small opening into the anterior tibial about one inch from its origin from an ulceration of the coats of the vessel." He also noted that there were recent adhesions "anteriorly and posteriorly in the left thoracic cavity but no effusion: the left lung was much congested but did not sink in water." The most interesting fact was that the cartilage, both of the femur and the tibia, were almost entirely removed and the bones looked "vascular and healthy." The cartilage it was feared would interfere "greatly with the bony ancylosis upon which the success of the case would depend." The secondary hemorrhage was ruled an accident, possibly the "result of his scorbutic condition which might have followed amputation." Thomson concluded:

> But for this complication it might have been my privilege to report a case of the knee joint treated successfully without amputation. Although the present attempt has failed, I will venture to predict that this method <u>if employed early</u> before the joint has been relieved of its morbid contents by a rupture of the synovial membrane will be found worthy of confidence. The most marked benefits followed the incisions in this instance and relieved the wound of all its supposed specific character. The rapid disappearance of the cartilages in twenty days removed one of my greatest anxieties since it renders ancylosis possible before the patient would be prostrated by profuse suppuration.[198]

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[197] Ibid.

[198] Ibid.

Thomson submitted the knee joint along with the lungs and concluded that the wet specimens and case history would make "valuable preparations" for the museum. While he experimented a little with this patient, albeit with a procedure he truly believed would be effective and with the patient's consent, after losing the patient he framed the case as a valuable learning experience to help others.

As the mortality from specific wounds accumulated, physicians tried to understand the reasons and also illustrated the difficulties associated with specific wounds through the specimens. A particularly difficult class of wounds was compound fractures of the thigh. R.B. Bontecou observed in a special report to Hammond that after treating the number of wounded that arrived from Lees Mills, South Mills, Williamsburg, West Point and Fair Oaks that "men with gunshot fractures of the thigh were in a pitiable condition" and their limbs were "distended with pus and disorganized blood."[199]He made these cases the subject of resections (removing a portion of the limb containing the shattered bone) versus removing the entire limb.[200]Bontecou excised the shaft of the fascia and soft parts to "give free outlet to pent up fluids and to relieve obstruction to circulation at the same time moving bone matter and foreign substances."[201] He was an advocate of conservative surgery, but noted that even with his meticulous care, "of fourteen cases but one lived to get a firm union of the femur" and the rest died of "pyemic hemorrhage."[202]It was a very challenging situation because of the extensive tissue destruction caused by the minie ball, which also usually shattered the bones. But an amputation of the upper thigh almost always proved fatal because the femoral artery would be severed leading to hemorrhage and quick death; however, if physicians did not amputate, soldiers often became infected with pyemia or osteomyelitis (bone infections.) The removal of an arm or leg, however, was considered a real loss and there was a feeling among some physicians that their colleagues amputated far too readily. There was a vast difference though between conservatism[203] and conservation. Physicians usually began their course of treatment with the questions "shall we amputate?" or "shall we put it up in

[199] RG 94 (NARA) Medical Records: Reports of Diseases and Individual Cases 1841-93.File A, Entry 59 "Hygeia Hospital Fortress Monroe, R.B. Bontecou's Report."
[200] Resections often led to more cases of infection and took much longer than amputation.
[201] Ibid.
[202] Ibid.
[203] Associated with resection also called excision.

splints and leave it just as it is?" It was a difficult medical situation and the debates were motivated in part by the type of submissions received at the medical museum. For example, in discussing his submissions to the AMM Keen observed after the war:

> It was my duty to gather and forward all the specimens that I could lay my hands upon. Among them I remember more than a score of knee-joints, every one of which with our then surgical resources should have been amputated. Conservative treatment of joints was an impossibility until antisepsis and asepsis made it not only a possibility, but a duty. The popular opinion that the surgeons did a large amount of unnecessary amputating may have been justified in a few cases, but taking the army as a whole, I have no hesitation in saying that far more lives were lost from refusal to amputate than by amputation.[204]

Many found after adopting conservative measures that the patient would need an amputation later. Others, such as Alexander Hoff advocated conservatism:

> Stats are beginning to show quite plainly what might have been anticipated and our surgeons are quite anxious to be in time with the report of successfully treated cases of compound comminuted fractures without surgical interference. I apprehend that there will be but a very few grateful patients where resections in continuity have been made, esp. of the femur to herald the greatness of the surgeon who made them on that the surgical history of the man.[205]

Elijah Ray of the Palmetto Sharp Shooters sustained a compound fracture of the thigh at the Battle of Fair Oaks, June 1, 1862, and assistant surgeons Dunglision and Hunt agonized over his case. The wound was described as a compound fracture of the thigh complicated by the ball still in the wound and great "comminuting from just above the condyles to the middle of the limb."[206]They elevated the limb and the wound was dressed with cerate and saturated charpie, which was replaced often. Ray was also given tonics, porter, quinine and a full diet; while he suffered fever at night, he was reported to be comfortable during the day. The doctors continued to monitor the wound and even asked in the case file "shall we amputate in this case? Our experience in secondary amputation of the thigh is so discouraging that we think our efforts to save the leg are fully justified."[207]After seven weeks of treatment and monitoring Ray succumbed to pyemic infection. The doctors then dissected the leg, carefully leaving the bullet intact

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[204] William Williams Keen, "Surgical Reminiscences of the Civil War" in *Addresses and Other Papers* (Philadelphia: W.B. Saunders and Co., 1905) pp. 432-433.
[205] Alexander Henry Hoff Papers, 1821-1876, MS C 484, (National Library of Medicine, Bethesda MD) Letter from Alex Hoff to Professor Alden March October 9, 1863, From Memphis Tennessee.
[206] RG 94 (NARA) Medical Records: Reports of Diseases and Individual Cases 1841-93.File A, Entry 621 "Special Cases in Ward D Fifth Street Hospital" Submitted by Surgeons Dunglison and Hunt, June 30, 1862.
[207] Ibid.

near the great trochanter. They also found huge amounts of liquid matter and pus in the leg, confirming that he had died of pyemia (septicemia). They submitted the leg, along with the bullet still attached, which was considered a highly valuable contribution.

Most interestingly, as the war progressed some physicians were easily able to recognize specific diseases associated with characteristic symptoms. A newfound confidence in the ability to understand diseases and wounds can be detected in some of the specimen reports. Dr. D.W. Bliss treated "forty very serious cases of typhoid fever" during the Peninsula Campaign,[208] holding autopsies in all cases and found "no typhus; all deaths from typhoid marked from hemorrhage from the bowels, one from coma all others apparently from pure exhaustion."[209]Physicians similarly learned to detect when specimens had been incorrectly prepared. Since their professional identity was now connected to their specimens, many aimed to ensure accuracy in their submissions:

> In the photograph album which I had the honor to send to the Army Medical Museum on the 18th of September there is on the 30th page a picture of a plaster cast of a shoulder joint from which the head of the humerus had been removed. In as much as this cast shows but imperfectly the nature of the operation and its result...I would respectfully request that the picture of Gallagher's shoulder on page 30 be removed and replaced by the enclosed picture of an excision of the tibia. I make this suggestion with a view to correcting what I consider a fault, and thereby increasing whatever of value to the collection it may have.[210]

Physicians also learned and gained experience from specimens obtained from living bodies. John Shaw Billings submitted the arm of Private J.H. Miles of Co. 24, VA after he had been wounded while loading his weapon at the Battle of Williamsburg, May 5, 1862. The minie ball entered his left arm on the outside about four inches past the joint.[211]The ball "passed inwards and upwards and was cut out just below the outer third of the clavicle of the same side." He was admitted to Cliffburne Hospital on May 17, 1862 in fairly good condition though his wound exhibited "moderate discharge of pus." The doctors decided at first not to amputate but rather to treat the patient with a

[208] Characterized as serious because of the hemorrhage from the bowels.
[209] RG 94 (NARA) Medical Records: Reports of Diseases and Individual Cases 1841-93.File A Entry 111 "Narrative of Service" Z.F. Bliss, Surgeon U.S.V, Camden Street USA General Hospital Baltimore MD, December 1863. He preserved the abdominal viscera and peyer's glands for the AMM.
[210] Incoming Correspondence. RG 13 OHA (NMHM) Letter to Brinton from James H. Armsby, Oct. 22, 1865.
[211] RG 94 (NARA) Records of the Adjunct General's Office, Records of the Record and Pension Office-Medical Records: Reports of Diseases and Individual Cases 1841-93. File A and Bound Manuscripts Entry 635, Cliffburne Hospital Report, Washington DC July, 1862.

nourishing diet and small doses of morphine while comfortably supporting the arm with cushions. While the patient's constitution continually improved, the local pain worsened daily. Billings placed the patient under ether and performed an "exploratory incision to determine the extent of the injury." He found that the humerus was "extensively split and shattered" making amputation of the shoulder joint the best option. He operated by oval method and noted in the case file that "not more than two ounces of blood were lost" and only "five ligatures were used and the flaps were closed by suture." Two weeks after the operation the ligatures were removed, simple cold water dressings were used and the patient was "perfectly convalescent." The arm was submitted to the AMM and the case history was published, believing it a model of how to diagnose and treat a wound.[212] Similarly, the physician J.B Brown, General Hospital Fourth and George Street, Philadelphia submitted the specimen of John Martin a Private, Co. G 4th New York Vols. who was wounded in the left leg, below the knee at Antietam. The case was deemed interesting because of the path the ball took: it entered at the "inner aspect of the left tibia fracturing it and the fibula at about 4 inches above the malleoli, passing down through the medullary canal of the tibia and emerging at the inner border of the astragalotibial articulation extensively comminuting all the bones in its course."[213]The leg was amputated below the knee, healed "kindly" by granular adhesion and promised to be "quite a useful stump."[214]In framing the body as useful in the development of scientific medicine, physicians adopted a rhetoric that separated the "soldier" from his specific body parts.

The thousands of letters that discuss the submission of specimens to the museum give an excellent insight into how the cabinet was built, the way in which physicians separated the identity of the soldier from his body and how physicians welcomed and exercised the access to human bodies that the war gave them. Physicians often wrote to the museum staff for advice about how to send specimens and almost always adopted a scientific rhetoric; in doing so, they gained a sense of pride and professional excitement from their ability to donate and contribute to the project. Reports often speak of specimens of an interesting character, with little mention of the patient. Dr. John S.

[212] Ibid.
[213] Ibid.
[214] Ibid.

Carpenter submitted a ruptured femoral vein, which was unique."[215]Other letters simply noted the number of specimens; for example, the physician John Morgan submitted that "by the boat that leaves tonight one keg containing 19 specimens and a full report of each case and also a list of all the operations that have been performed."[216]Some physicians, such as W.F. Norris, often sent as many as 40 pathological specimens in one keg.[217] Some of the case books are simply entitled "specimen histories," contain hundreds of case reports relating to the specimens and reduce the soldier to his most useful parts:

> I have the honor to transmit herewith the following surgical specimens for the Army Medical museum: William Haynes Priv. Co. F 38th Wisconsin bones of hand and 2 inches of lower portion radius and ulna.; Orson Randolph Priv. Co. C 67th N.Y.V. Knee-joint; David Hyam Priv. Co. C 5th New Hampshire-two specimens-knee joint and head neck and upper portion of shaft of femur; Wm Johnson. Priv. Co. F 1st. Head and upper portion shaft of tibia, missile lodged in head of tibia; John Doran-Priv. Co. D 1st bones of foot and lower third of tibia and fibula; Walter D. Boyce Priv. Co. D 124th NYV seven inches shaft of right ulna forearm; John B. Leshender Priv. Co L 4 NY. Complicated dislocation of ankle joint-foot and lower tibia and fibula.[218]

From a professional point of view the war represented an unprecedented opportunity for medical practitioners to develop their skills and the specimen histories reveal that they gained extensive experience with the body. As physicians visited the museum and read the corresponding case history, they saw the complexity of scientific medicine which orthodox American physicians who doctored in the war were now uniquely qualified to manage. William Rothstein argues that "it was not until the 1890s, after medical schools had adopted three year graded curriculum and after the state licensing boards demanded improvements, that medical schools instituted laboratory courses in pathology, bacteriology, chemistry and physiology."[219]It is very significant that Civil War physicians found support for the development of investigative medicine and institutional support for the medical sciences, which preceded the educational reforms of the late nineteenth century. Research on bodies was framed as useful for the soldiers still living but it was also important for the education of the individual physician

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215 Incoming Correspondence. RG 13 OHA (NMHM). Letter to Brinton from John Carpenter, May 7, 1863.
216 Ibid. Letter to Brinton from John Morgan March 19, 1863.
217 Ibid. Letter to Brinton from W.F. Norris, Douglas General Hospital, Oct. 19, 1865.
218 RG 94 (NARA) Medical Records 1814-1919, File D Box 28 "Specimen Histories" submitted by A.A. Hudson, U.S. Volunteers, Carver US General Hospital to Barnes, June 21, 1865.
219 William Rothstein, *American Medical Schools and the Practice of Medicine: A History* (New York: Oxford University Press, 1987) p. 106.

and became the context in which the use of bodies was framed. As the century progressed, the museum's collection reflected the aspiration of American surgeons to continue to contribute to the development of the medical sciences. John Shaw Billings observed in 1888 of the Army Medical Museum:

> An important feature of our National Medical Museum should be to show methods of research and of instruction for the benefit of the investigators and teachers of the country… For example, as soon as Koch's researches became known in this country, physicians, and especially medical teachers who visited the museum asked if we could show them the apparatus used by Koch and Pasteur in bacteriological work, and eagerly examined the few specimens of cultures in solid media which we were able to exhibit. The anatomist come to the museum quite as much to see methods of mounting and preservation as to see the specimens themselves; the physiologist does not expect to see function directly exhibited, but he does hope to find information about kymographs and constant temperature apparatus, and he wants to see whether Kuhne's artificial eye is so useful for teaching purposes that he ought to get one to illustrate his lectures.[220]

The war was an important period of training for the orthodox physicians and proved a stimulus for the development of many new forms of scientific knowledge. The remainder of this chapter examines how scientific medicine developed with experiments on the dead body through deaths from chloroform and with living bodies through experiments related to malingering.

Death From Chloroform:

The themes of death, research and scientific medicine coalesced around the use of chloroform during the war. Introduced in 1847 by Sir James Young Simpson,[221] chloroform was first used, though very rarely, during the Mexican-American War (1846-47). Physicians began using it in civilian practice in the late 1840s and 1850s and it was extensively used during the Civil War. Anesthetic was very new to some Civil War physicians, though many had read about its use in the Crimean War. In his manual on military surgery Samuel Gross remarked:

In the war in the Crimea, the British used chloroform almost universally in their operations; the French also exhibited it very extensively, and Baudens, one of their leading military surgical authorities, declares that they did not meet with one fatal

[220] John Shaw Billings, "Medical Museums" *Science* Vol. 12, No. 294 (Sept. 21, 1888): 134.

[221] Although as Keen remarked, chloroform had been used as early as 1846 in the Massachusetts General Hospital on Oct. 16, 1846. See "Surgical Reminiscences of the Civil War" p. 430.

accident from it, although it was given to them during the Eastern campaign, thirty thousand times at least.[222]

The Union records show that of more than 80,000 operations performed only 254 were done without some kind of anesthetic.[223]Chloroform was the anesthetic of choice because it was easily inhaled, acted quickly and was thus seen to be more efficient than ether. But a mix of ether and chloroform was also used since the application of pure chloroform had been associated with death.[224] When administered improperly, chloroform can cause cardiac arrest leading to sudden death. There had been a number of deaths associated with the use of chloroform in civilian practice prior to the war but the reason was unclear; soldiers' bodies were once again a resource to develop medical knowledge.[225]When a patient's death was attributed to chloroform the medical department sponsored an investigation, specifically into the method by which the chloroform had been administered and the chemical makeup of the chloroform. The point was less to answer the family than understanding and learning about the cause of death involving anesthesia. Ian Burney has argued in relation to the British medical profession, "it was not the absolute number or relative frequency of deaths under anesthesia that occupied the attention of the medical profession so much as the fact that the phenomenon was recurrent and afforded no clear causal explanation."[226]Burney demonstrates that the

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[222] Samuel D. Gross, *A Manual of Military Surgery or Hints on the Emergencies of Field, Camp and Hospital Practice* (Philadelphia, Lippincott, 1861): pp. 81-82.
[223] Bollett, p. 78. In almost every report that I read anesthetic was employed.
[224] Chloroform is an organic compound, which is a colorless, sweet smelling dense liquid. It works by depressing the nervous system. If a fatal dose is given (or taken) the immediate symptoms are dizziness, headache and extreme fatigue and in the worst cases death, which is caused by respiratory or cardiac arrest. For modern day discussions on chloroform see, J. de Fouw, "International Program on Chemical Safety" (World Health Organization, 1994); Linda Stratmann, *Chloroform and the Quest for Oblivion* (The History Press, New York, 2005); Peter Vinten Johansen, Howard Brody, Nigel Paneth, Steven Rachman, Michael Rip, *Cholera, Chloroform and the Science of Medicine: A Life of John Snow* (Oxford University Press, Oxford, 2003).
[225] Beginning in the late 1840s deaths from chloroform were amply reported in medical journals, and the public and press encouraged physicians to abandon its use (mostly in Europe and the UK). Physicians responded that the superior skill of the physician would prevent death from chloroform (conferring a measure of status for the physician). The eminent British physician John Snow undertook numerous experiments on chloroform (narcoticism: on administration, vapour and quantity dissolved in the blood, chemistry, temperature, autopsies, nerves, patient's constitution, physiology of chloroform). His experiments were considered the most scientific up to that time and the Medical Society of London chose Snow to speak on "Continuous Molecular Changes" a biochemical analysis on the basic mechanisms of narcotic vapors. Please see, Peter Vinten Johansen, Howard Brody, Nigel Paneth, Steven Rachman, Michael Rip, *Cholera, Chloroform and the Science of Medicine: A Life of John Snow* (Oxford University Press, Oxford, 2003) Chapter 6. See also John Snow, *On Chloroform and Other Anesthetics* (ed) Ben Ward Richardson (London: Churchill, 1858). The important point is that scientifically minded physicians viewed death from chloroform as an interesting scientific question and looked for ways in which to produce knowledge about the phenomena.
[226] Ian A. Burney, *Bodies of Evidence: Medicine and the Politics of the English Inquest, 1830-1926.* (Baltimore: Johns Hopkins University Press, 2000) p. 139. Chapter 5 examines "Anesthetic Deaths and the Limits of Public Inquiry."

"question of anesthetic death formed the subject of inquiry for numerous medical and parliamentary commissions from the 1860s onward, but their investigations produced no clear consensus, leaving the question of anesthetic death at the turn of the century largely open."[227] This was also the case during the Civil War, and some physicians were at the forefront in investigating the matter and able to develop and transmit knowledge from their research on soldiers' bodies. A number of questions precipitated their investigations: was the death the result of the toxicity of the chloroform, the way or circumstances under which it was administered or was it owing to the patient's weakened constitution? Chloroform was used extensively, but was it part of the movement for "humane surgery" or were patients being exploited, objectified and rendered insensible to the potential destruction that could be caused by it? As shown in the investigations related to gangrene and erysipelas, the use of anesthetics during the war allowed for the development of investigative medicine; but at what expense to the patient? Burney suggests in regard to anesthetics, "...a humane surgery was the outcome of a salutary dehumanization: an objectified patient, insensible both to the negative consequences of this invasion, and a surgeon who, freed from this complication of pathos, was capable of skillful fidelity to the knife's clarity of purpose."[228]The case reports concerning death from chloroform are more defensive than most of those submitted to the Surgeon General's Office, probably because these inquiries challenged the skill and professional status of the physician.

A number of issues plagued Civil War physicians regarding anesthetics. Some doctors believed that chloroform depressed the nervous system and advocated the use of stimulants in conjunction with it; [229]others believed that stimulants lessened the effect of the chloroform (Virchow wrote about the incompatibility of chloroform and alcohol in Virhow's Archiv, April 15, 1870). Some physicians advocated the exclusive use of ether, some swore by a combination of the two agents while others discarded anesthetics altogether.[230] But the war once again proved an important forum to test theories and

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[227] Ibid. pp. 139-140.
[228] Burney, pp. 143-144.
[229] During the Civil War if patients were found to have "deficient tissue excitability" they were given stimulants. Alcohol was considered a stimulant and was prescribed often. Please see, Bollet pp. 232-33; Michael A. Flannery, *Civil War Pharmacy: A history of Drugs, Drug Supply and Provision and Therapeutics for the Union and Confederacy* (New York: Pharmaceutical Products Press, 2004); George Winston Smith, *Medicines for the Union Army: The United States Army Laboratories During the American Civil War* (New York: Pharmaceutical Products Press, 2001).
[230] RG 94 (NARA) Medical Records 1814-1919, File D, Box 36. "Report for George Otis from Geo. F French on the "Propriety of Giving Stimulants previous to administering ether or chloroform."

conduct experiments, which supported the development of investigative medicine. There was an important relationship between theory and practice in these investigations, foreshadowing the modern medical model that developed with the ascendancy of laboratory medicine. Physicians could compile a vast amount of information pertaining to deaths from chloroform and correlate clinical and post mortem information, creating both a record of the phenomena promising improvements in knowledge and practice. Civil War physicians undertook experiments related to deaths resulting from anesthetics but the first major textbook which tackled the subject in its entirety, Dudley Buxton's *Anesthetics: Their Uses and Administration*, did not appear until 1888.[231]Barnes was interested in the subject both during and after the war and in 1865 issued a circular to all medical directors:

> Medical Directors will require of all medical officers under their direction a strict compliance with the following instructions: In all cases, either in hospital or in the field, in which death is supposed to result from the employment of anesthetic agents, a detailed report of the attendant circumstances will be transmitted by the medical officer in immediate charge of the patient, through the ordinary channels, to the surgeon general. Medical officers in charge of hospitals and surgeons in chief of divisions will endorse on the reports of their subordinates their opinions of the facts. Together with the report, a sample of the anesthetic agent employed will be forwarded for analysis.[232]

At the request of Barnes, George Otis submitted his "Report on the Fatality of Anesthetics during the Present War" in February, 1865. He examined hundreds of papers from medical officers in the field in the hope of "corroborating the conclusions of the surgeons who served in the Crimean and Italian Campaigns" to prove the "almost universal applicability of anesthetic agents in operations necessitated by gun-shot wounds."[233] Of 1710 cases analyzed, Otis found that chloroform was used in 1000 cases, ether in 500 and a mixture of the two in 210.[234] In most cases the patients died within 5-10 minutes after its administration. Surgeon McParlin, Medical Director of the Army of the Potomac, Surgeon Cooper, Medical Director of the Army of the Cumberland, Surgeon Moore, Medical Director of the Army of the Tennessee and Surgeon Ghiselin,

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[231] Burney p. 140. Pharmacology was not promoted as a specialty until the late nineteenth century.

[232] RG 112 (NARA) Issuances and Forms: "Excerpts of War Dept. Special Orders Relating to Medical Personnel," Entry 57. Circular No. 2 Issued by Joseph Barnes March 15, 1865. A similar order had been submitted to medical directors in 1862 from Hammond.

[233] RG 94 (NARA) Records of the Adjutant General's Office: Medical Records, 1814-1919 File D, Entry 11 George Otis, "Report on the Fatality of Anesthetics during the Present War in February, 1865"

[234] Ibid.

Medical Director of the Middle Military Campaign for the summer campaign of 1864, together recorded 5284 cases in which chloroform was administered in primary operations of gun-shot wounds. Otis also determined that 5022 cases in general hospitals used anesthetics in primary operations. Overall he estimated that more than 80,000 wounded had been administered chloroform. He concluded "that we have had fatal accidents to deplore from the use of chloroform" but the number of deaths was quite low in relation to use. He could not at that point judge how many. But years later in the *Medical and Surgical History* it was estimated that there were only 5.4 deaths for every thousand cases.[235]Otis submitted a synthesis of six cases of death from chloroform in his report but found no clear cause. He notes in all the cases that "chloroform was carefully administered," the "operations were performed in the open air" or in ventilated rooms and "most patients died in the midst of operation"; for the most part there were no "pathological appearances found to indicate the cause of death." Barnes asked him to consider whether the use of chloroform somehow led to pyemia or increased the liability to secondary hemorrhage and on both counts Otis found that the use of chloroform was not a contributing factor.[236]

The government was careful to protect their interests. Joseph Barnes wrote a letter to Edwin Stanton, Secretary of War in which he noted, "Experience has shown that in order to secure the government against fraud or carelessness in dealers, drugs, legions, extract of beef etc. should be carefully tested by a subsequent chemist."[237]Barnes organized a chemical laboratory in Philadelphia for the purpose of conducting experiments on the "relative purity and value of samples and in preparing such articles."[238] He reported that in the laboratory in Philadelphia powders, pills, ointments, tinctures etc. "had been found in its experimental operations to be advantageous and economical."[239]At the request of the medical department, the physician B.F. Craig submitted the detailed results of some of his experiments on June 30, 1865. He examined the government issued chloroform along with "other such kinds of chloroform with a

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[235] Medical and Surgical History, Part III, Volume II pp. 887-95.
[236] Ibid.
[237] RG 112 (NARA) "Issuances and Forms: Excerpts from the War Department. Special Orders Relating to Medical Personnel," Entry 46. Report from Barnes to Stanton, Oct. 2, 1863.
[238] Ibid.
[239] RG 112 (NARA) "Issuances and Forms: Excerpts from the War Department. Special Orders Relating to Medical Personnel," Entry 46. Report from Barnes to Stanton, Oct. 31, 1863.

view of determining how increased precautions in the purchase and manufacture of this article might be necessary."[240]He based his conclusions on the following directive:

The pharmacopeia of the US directs that chloroform should have a specific gravity not less than 490 nor exceeding 494, and that when shaken with an equal bulk of sulphuric acid, it should not generate any sensible amount of heat nor impart to the acid any considerable amount of color. It should also be neutral or nearly so in its action on litmus paper.[241]

Craig examined the specific gravity, color, the presence of alcohol, the smell and its composition after being mixed with pure sulphuric acid. He compared the varieties of chloroform that he had obtained (both privately sold and government issued); of nine samples tested only three in use were found to be of "proper composition"[242]and concluded:

As far as can be judged, the chloroform in the possession of the USA medical department is very largely of inferior quality and that the impurities present are such as increase seriously the tendency to unpleasant accidents from its use. The faults in its preparation seem to be chiefly an imperfect performance of the washing with sulphuric acid directed by the pharmocopeia and a neglect to add a sufficient amount of alcohol to prevent the decomposition which is liable to take place in absolute chloroform..... I believe that none of the chloroform ordinarily sold is really fitted for the purpose of inhalation excepting that which is offered as purified chloroform and labels of certain well known manufacturers. These kinds are held at high prices from which it is to be inferred that the proper purification of chloroform involves much trouble and expense. What is wanted to ensure the good quality of the chloroform used in the army seems to be that it shall always be purified at the army lab until rigorously answers the prescribed tests, and that samples in store shall be reexamined from time to time to ascertain whether they have become acid in keeping. Chloroform now on hand which discolors sulphuric acid when shaken with an equal bulk of it which reddens litmus paper decidedly, might be turned in for purification or labeled as impure and kept for use as an external application.[243]

Chloroform minimized the pain for the patients but also rendered him a pure surgical object, giving physicians' tremendous power. Human bodies could now provide instruction as well as material for experimentation. But physicians in turn had to answer to the medical department about the use of chloroform and often came under close

[240] RG 112 (NARA) Office of the Surgeon General Letters Received, Entry 12. To Woodward from B.F. Craig June 30, 1864.
[241] Ibid.
[242] These included Dr. Squibb of Brooklyn, the Laboratory in Phil and from the Medical Purveyor in Washington. Of the six samples found to be "objectionable" five came from labs in Phil and one was of unknown origin.
[243] RG 112 (NARA) Office of the Surgeon General Letters Received, Entry 12. To Woodward from B.F. Craig June 30, 1864.

scrutiny as part of the more structured nature of American medicine during and a result of the war. In addition to the chemical analysis of the chloroform, the Surgeon General's Office requested a detailed account of the circumstances under which it had been administered and the postmortem results. Physicians were asked to consider the physiological effects of the anesthetic in particular its effect on the heart, brain, blood and respiration. On May 12, 1865 I. Houston, Surgeon 81st PA Vols. submitted his case report regarding John Johnson, who died during the administration of chloroform which he was given prior to an operation for the removal of a large portion of the right humerus due to necrosis following a gunshot wound. Houston suggested that he did not want to administer the chloroform but "the patient requested that he might have it."[244] Three doctors were present and after consultation, decided to administer the anesthetic "with the usual plentiful admixture of air and he seemed to come under the desired influence quite kindly." The patient's pulse was "good" and his breathing "regular" so the doctors stopped administering the chloroform and began the operation; but shortly after "respiration was suspended and the circulation ceased." They immediately "dashed cold water on his face" held "ammonia to his nose," "forced air into his lungs" and finally, applied galvanism; but except for a few "spasmodic inspirations, no sign of returning animation was evidenced." They conducted an immediate post mortem but it disclosed no "morbid appearance to throw light on the case: lungs were collapsed but healthy looking and the heart in a seemingly normal condition."[245]

The physician Henry L. Hewitt, Frederick Hospital No. 5, was similarly asked to provide further details in the case of D. Zebriske, Co. J 12th Alabama, who had been admitted to the hospital 18 October with a flesh wound entering the opposite side of the left hip, traversing the deep portion of the gluteal muscles.[246] An operation was performed on the 19th to "search for, and remove, the ball." Chloroform was administered and the operation commenced but "he quickly ceased to breathe." Hewitt engaged in a "rigid cross examination of the surgeon and attendant" but he failed to discover any "evidence

[244] RG 112 (NARA) Office of the Surgeon General Letters Received, Entry 12. "Death from Chloroform" From Mower General Hospital May 12, 1865 to Barnes.
[245] Ibid.
[246] RG 94 (NARA) Records of the Adjutant General's Office: Medical Records, 1814-1919 "D" File "Death from Chloroform".

of neglect of ordinary precaution."[247]In the post mortem the physician examined the brain and heart specifically, since in cases concerning the improper administration of chloroform Hewitt often found that patients would slip into a coma, experience a "fluttering heart" and suffer from general anemia. He also commented on the "curious fact" that chloroform had produced a "general depression to the system," which he attributed to the shock of the operation. Otherwise his findings shed little light on the physiological breakdown caused by chloroform.

Some physicians did suggest that there was a constitutional predisposition to death from chloroform. Physicians W.E. Ely and A.S. Whaler of the McClellan USA General Hospital, were asked to submit the case report of Robert Gormley, Private Co. I, 7th N.Y. Artillery who was admitted to the hospital June 13, 1864 after suffering a gunshot wound to the lower third of the right leg. It was determined that the ball was still present and Ely and Whaler performed an operation to remove it. They noted that "chloroform was employed as the anesthetic agent and was given with great caution and inhaled with perfect facility."[248]The patient's pulse "continued fine and nothing of unusual interest presented itself until the incision had been made" but almost immediately they were "deterred from proceeding to search for the ball by a spasmodic rigidity of the muscles such as generally occurs immediately before the point of complete anesthesia is attained."[249] Up to that time the patient seemed generally fine but he then "threw his head back and almost immediately expired."[250]They tried the usual methods to revive him (cold water in the face, ammonia to the nostrils, opening his mouth to draw the tongue forward, rolling him from side to side, and Whitehall's method of artificial respiration, which was kept up for an hour) but the patient did not respond. The physicians swore that the chloroform was administered in much the same manner as all surgical cases in which there had been few negative effects. Finding "no specific symptoms produced by the chloroform," they attributed the death to "some unknown idiosyncrasy of the patient."[251]

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[247] He was defensive likely because it was a southern solider and there were often inquests at hospitals to make sure they were being treated properly.
[248] RG 94 (NARA) Records of the Adjutant General's Office: Medical Records, 1814-1919 "D" File, Entry 120. "Death from Chloroform."
[249] Ibid.
[250] Ibid.
[251] Ibid.

Surgeon Jas. Blaney and Surgeon Wm. B Wyme submitted a particularly interesting case report concerning the death of Corporal Ballou, Co. E, 14th Pennsylvania Cavalry Volunteers, who received an "accidental wound" of the phalangeal bones of the index and middle fingers of the right hand. The bones were "very much comminuted, the fractures extending into the joints causing anchylosis of the joints led to "excruciating pain in the fingers," which was so intense that he could not perform his duty for two months. It was therefore decided to remove the fingers (at the patient's request).[252]The patient's overall health was assessed and it was decided that he "had no disease of the heart or lungs" which would have made the use of chloroform unadvisable. It was inhaled by the patient "without unpleasant symptoms" and when he was "sufficiently under its effect" the operation began. The patient experienced pain when the index finger was removed so he was given "a small portion more" in order that the middle finger could be removed. Almost immediately the patient struggled violently and the "arterial hemorrhage ceased to flow."[253]The doctors instantly examined his tongue and found "it had fallen back," at which time they began the "usual method of exciting respiration." Wyme noted that the patient had not been under the anesthesia for more than five minutes when this occurred. The autopsy was performed almost immediately, disclosing that the lungs were healthy but the heart showed the appearance of slight ossification. They concluded that death was the result of "immediate paralysis of the heart." Interestingly "the brain was not examined, at the request of his friends, stating that they wished to send his body home."[254]Once again this suggests some cooperation among soldiers and physicians: parts of the body could be studied for the benefit of science as long as the remainder could be transported home and presumably be recognizable.

In a similar case, Thomas Hamilton, Private Co. A 1st Regiment, M.D. infantry entered the General Hospital at Patterson Park, Baltimore, M.D. with erysipelas of the right arm.[255]He had already lost two fingers to the disease. In consultation the resident physicians decided to remove the carpal bones, which had become separated and

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252 RG 94 (NARA) Records of the Adjutant General's Office: Medical Records, 1814-1919 "D" File, Entry 386. "Special Report of Surgeon WM. B. Wyme concerning the Death of Corpl. Ballou"
253 Ibid.
254 Ibid.
255 RG 94 (NARA) Records of the Adjutant General's Office: Medical Records, 1814-1919 "D" File, Entry 122 "Report on a Case of Death from Chloroform" submitted by Physicians Cherbounier, Kempster, Fay and McLetchie, Patterson Park, Baltimore M.D. Sept. 7, 1864.

displaced from the ligaments. He was placed on the operating table and "one of the surgeons commenced administering chloroform" while another "held his fingers on the pulse." The chloroform was administered via a sponge, which was "carefully held at first, some three or four inches away thus giving perfectly free access of atmospheric air."[256] The patient breathed in the chloroform for about five minutes but began experiencing "muscular contractions" which were "more violent than usual." As his pulse grew feebler administration of chloroform was stopped and the doctors attempted to "restore natural breathing" by the usual methods stated above; but the patient soon died. The report noted that since the patient was a resident of Baltimore, "his friends soon learned of his death and strenuously objected to a post mortem examination, but were finally persuaded to allow an examination of the heart."[257]The doctors opened the chest and found the heart normal in size and appearance, both auricles distended with venous blood but the ventricles empty. A clot was found in each auricle, each about two and half inches long. Once again "the surgeons were obliged to forego the autopsy of the brain and other parts, which was very much desired, lest the friends should think the body was unnecessarily mutilated."[258]

There were few clues obtained in the postmortems which supported the findings of John Snow's 1858 publication *On Chloroform* in which he wrote: "The appearances met with on dissection do not differ from those that are found in many cases, especially of sudden death."[259]As Burney demonstrates, fifty years later these views were still considered "the received wisdom of the profession."[260] But some of the postmortems related to deaths from chloroform during the Civil War were so detailed that they well illustrate how the body was used in the attempt to develop scientific and investigative medicine. The physician R.W. Forrest, Assistant Surgeon US General Hospital No. 8, Nashville, TN submitted his case report of Lewis Winter, Private CO. J 11th Michigan Volunteers on October 28th, 1864.[261]Winter had died during the administration of chloroform prior to an operation for his gangrenous right thigh. The report clearly states

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[256] Ibid.
[257] Ibid.
[258] Ibid.
[259] Quoted in Burney, p. 163.
[260] Ibid.
[261] RG 94 (NARA) Records of the Adjutant General's Office: Medical Records, 1814-1919 "D" File, Box 36 "Case of Death from Chloroform." Submitted by R.W. Forrest, Assistant Surgeon US General Hospital No. 8, Nashville, TN.

that Forrest "with the patient's consent" commenced to administer chloroform with a sponge, in a well-ventilated room.[262]Winter suffered the customary spasms, failed to respond to the attempts at resuscitation and died shortly after being administered the anesthetic. Two hours after death Forrest performed the autopsy, which was one of the most detailed postmortems related to anesthetic deaths. He began by looking at the body in general which was reported as being in "good condition," with the exception of the back of the neck and chest which were "discolored." He noted the immediate effects of the wound which was in a half state of "healthy granulation" and "active gangrene." He next cut through the scalp and noted the blood was "fluid," "dark colored and flowed freely." He removed the cranium membrane which revealed the "usual healthy appearance, white and glistening." He then proceeded to remove the membranes and sinuses both of which were filled with "serous effusion" and "dark fluid blood." Forrest studied all the vessels in the surface of the brain and found them "much congested." He also performed a detailed dissection of the brain, most of which was found normal except the choroid plexus which was "darker than normal and congested" and the fifth ventricle which was "moist." He then moved to the chest and examined the lungs once again in extensive detail, finding them "deeply engorged with dark blood" with a frothy surface and "numerous deposits" at the base of the lungs and a few at the apex. The heart was "perhaps just a little thinner and more easily torn" but all the valves were "normal." Finally, he looked at the kidneys, spleen and bowels but found no evidence of abnormality as a result of the chloroform. The postmortem reports illustrate the difficulty that Civil War surgeons had in finding a common pathology which would help to shed light on the physiological breakdown caused by chloroform. The argument here is not that bodies were simply exploited for the benefit of science: the investigations were framed as being crucial in developing knowledge that would save other soldiers and this was helped by this extensive access to the body. Physicians looked deep into those made available by the war to search for clues about these mysterious deaths, and those who died as a result of the government's chloroform or from the physician's administration. Chloroform became material for developing scientific knowledge. In producing this knowledge, physicians adopted new methods of investigation including physical

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[262] Ibid.

measurements such as microscopy and chemical analysis and increasingly focused on physiological science.

Living Bodies and the Development of Scientific Medicine:

Some doctors enthusiastically studied dead bodies while others learned from the living. This was most evident in the investigations of malingering, where the physician's ultimate power might have been challenged if the feigned illness could not be exposed.[263] Joanna Burke, in her study of men's bodies during the First World War, argues that when it came to malingering, the "only weapon the malingerer had was his body."[264] Indeed, she demonstrates that the malingerer's "protest *centered* on his body" which was "often the last remaining thing he could claim as his own."[265]Woodward discussed malingering in his *Outline of Chief Camp diseases* as follows:

> Considerable difference of opinion has existed in recent times on the subject of malingering, and there are not wanting, those who dispute its frequency. An acute observer and eloquent writer, Miss Florence Nightingale, denies its existence, except in very rare cases among the British troops in the Crimea, and seems to regard the instances quoted by some of the medical officers, as evidence rather of ignorance of the surgeon than of the delinquency of the soldier. Without in any way wishing to controvert the opinion of this illustrious lady, so far as the British Army in the Crimea is concerned, it is impossible for any careful observer who has been familiar with the military hospitals of the United States armies during the first two years of the war to deny that malingering of every kind has been exceedingly common.[266]

It was mandatory for physicians to determine a way to detect malingering since if they could not, it challenged the ownership of bodies that the military had worked so diligently to enforce and the newfound medical authority that physicians had worked so hard to develop. As one soldier remarked:

> The surgeon could or would not distinguish between the really sick and those who were playing off. It was my first and last visit to the surgeon. I ever after preferred to do

[263] This chapter is concerned with how the medical profession used the bodies under their care to develop knowledge. The study will examine experiments related to malingering and will exclude those soldiers who were admitted to the Government Hospital for the Insane (who were usually admitted after some form of criminal behavior)-- the question of malingering also existed when diagnosing insane soldiers, but their records will not be the focus in this study. Keen discussed insanity and suggested that it was forbidden to discharge insane men from the Government Insane Asylum but as he pointed out "anyone who would feign insanity and submit to its restraints and associations to avoid work and obtain ease, must be in reality a monomaniac." Keen, Mitchell and Morehouse, "On Malingering, especially in regard to simulation of diseases of the nervous system" *American Journal of Medical Science* (48) (October, 1864): p. 377.

[264] Joanna Burke, *Dismembering the Male: Men's Bodies, Britain and the Great War* (Chicago: The University of Chicago Press, 1996) p. 81.

[265] Ibid.

[266] Joseph Woodward, *Outlines of Chief Camp Diseases of the United States Army: As Observed during the Present War* (Philadelphia: Lippincott, 1863): p. 325.

> my duty if not feeling well, than to trust myself in the hands of a surgeon who could not tell a real sick man from one who was not. I have no hard feelings against the Surgeon, although at the time I did not think he did his duty as he ought to have done...I know the boys used to play on him by feigning sickness, and in all ways imaginable, but he should have looked to one's record and inquired of the company officers if he could not decide.[267]

Soldiers who served in the War relinquished their bodies for the duration. Malingering was a medical challenge representing the ultimate contest over bodies: the physician's skill in diagnosis against the malingerer's desire to obtain a Medical Certificate of Discharge. In 1863, Roberts Bartholow published *A Manual of Instructions for Enlisting and Discharging Soldiers: With Special Reference to the Medical Examination of Recruits, and the Detection of Disqualifying and Feigned Diseases.* He warned physicians to use superior medical skill to distinguish and thus control malingerers. The whole efficiency of the army depended on the "utmost skill and ingenuity in detecting feigned, factitious, aggravated and exaggerated diseases" but also to be able to discharge those "disqualified by infirmities which escaped the observation of the examining surgeon, or who have become disabled by accidents or diseases incident to military life."[268]In his manual Bartholow provided an account of the "true symptoms for diseases" which were more likely to be feigned or simulated by resourceful soldiers. He covered everything from infections of the eye, nose and mouth, to nervous diseases, internal diseases, heart disease, diseases affecting the upper and lower extremities and even skin disorders. Men were morally weak if they were malingering and had to be rooted out so that they would not affect the overall quality of the military. Woodward admonished the whole military system of the country during the war because he suggested that it "favored and encouraged malingering" by not immediately recognizing when patients discharged from the service for disability from disease re-enlisted in other state organizations. He derided the "enormous bounties" and the "general looseness of discipline" at the beginning of the war, the result of long held republican values, and the inexperience of newly appointed surgeons to detect shirkers.[269]Like Bartholow, he

[267] "Three Years with Company K": Sergeant Austin C. Stearn, Company K, 13[TH] Mass Infantry (ed) Arthur Kent (New Jersey: Associated Press, 1976): p. 49.
[268] Roberts Bartholow, *A Manual of Instructions for Enlisting and Discharging Soldiers: With Special Reference to the Medical Examination of Recruits, and the Detection of Disqualifying and Feigned Diseases* (Philadelphia: J.B. Lippincott, 1863) pp. 10-11.
[269] Woodward. p. 326.

warned physicians to beware of the true symptoms of the diseases that were easiest to feign, such as rheumatic affections, particularly chronic rheumatism. He advised surgeons that "pain whether simulating headache, neuralgia, rheumatism, affections of the muscles, bones, joints is a symptom of disease so easily pretended that it is not to be admitted as a cause for exemption, unless accompanied with manifest derangement of the general health, wasting of a limb or other positive sign of disqualifying local disease."[270] Woodward advised sending malingerers to Turner's Lane Hospital since nervous diseases were easiest to simulate and some of the investigations there centered on pain.

It was no surprise that the majority of experiments related to malingering were the result of the research at Turner's Lane Hospital. By 1863 the physicians in residence there could offer a much deeper account of nervous diseases than had been advanced by Bartholow from their wide range of experience of treating nervous patients. As Silas Weir Mitchell observed, "It became the custom to turn over to us the cases suspected of malingering. These were the scamps or cowards, and in some cases victims of a strange form of psychic disorder."[271]The most significant publication of this wartime research appeared in the *American Journal of the Medical Sciences* for October, 1864 based on experiments to expose malingering which specifically focused on simulation of diseases of the nervous system. This research was once again developed in response to the large number of Civil War nervous cases. It was a contest for power as Keen observed: "The older soldiers are fast learning deceit, and if we are to be mistaken, the attempts of the malingerer are now much more frequent, and far more clever than they were two years ago."[272] The men could have been court-martialed but how could a court of "non-professional men" determine whether a person was indeed a malingerer?[273]Devising means to identify the malingerer once again confirmed the scientific authority of the orthodox medical profession.

Malingering could be divided into two categories: those who exaggerated "real maladies of trifling character" and those who "feign disease outright." Most of the

[270] Ibid. pp. 326-327.
[271] Silas Weir Mitchell 'The Medical Department in the Civil War" (Philadelphia, 1914) P. 16.
[272] Keen, Mitchell and Morehouse, "On Malingering, especially in regard to simulation of diseases of the nervous system" *American Journal of Medical Science* (48) (October, 1864): 367-394. p. 367.
[273] Ibid. p. 369.

Turner's Lane cases fell into the first category.[274]Before the authors detailed their investigations they acknowledged the ethical difficulties. For example, "Let us suppose the case of a man, as to whom all our information have been used" and yet "we still feel confident that he is malingering," then "what is the surgeon's duty here?" They reasoned if he is a "well man" no harm was done but if he really was in fact sick and they failed to detect the disease, "then he is pretty sure to find his way to a hospital again."[275]Two things are clear from their reasoning: they had great confidence in their ability to diagnose a wide range of diseases but if they failed to diagnose it a colleague would do so later; most important, the physicians held the power in the relationship perhaps at the expense of the patient's life (if he could not for example get to a hospital). But Keen, Mitchell and Morehouse reckoned that death was unlikely since these cases were "almost invariably chronic" and should not be injured "by a simple journey and an attempt at duty."[276] They were concerned with cases of "undoubted and obstinate malingerers" which they aimed to expose through tests and signs. Once again the rights of the individual soldier were subordinated to the greater good; this was necessary because "men malinger to avoid work and obtain a discharge and so long as one succeeds in doing either, so long will ten others continue to imitate him."[277]Physicians were encouraged to be vigilant and adopt every means "to ascertain positively the reality of the deception."[278] The authors suggested that doctors must become detectives in order truly to expose every malingerer. The attempts at discovery were handled in a variety of ways. Men who were feigning diseases such as paralysis, lameness or chorea were monitored when they were outside the hospital enclosure to "see how they act and to hear what they say when they are drunk." [279] Doctors were also advised to study the character of the malingerer to get a sense of whether he was trustworthy or more likely to falsify statements. They were further cautioned that "every means that the science or the ingenuity of the surgeon can

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[274] Ibid. p. 367. In contrast to some of the European soldiers, they found instances in which the solider self mutilated very rare.
[275] Ibid. p. 368.
[276] Ibid.
[277] Ibid. p. 369. This quote also suggests that the record of this work would be useful for employers to identify malingerers after the war when the men returned to factories or other means of difficult labor. In fact, the article continually links labor and war service.
[278] Ibid.
[279] Ibid.p. 370.

command is needed" in order to expose malingerers.[280] Doctors needed to be vigilant because soldiers would use their bodies to deceive physicians: they would submit to the pain of dry galvanism, cautery, setons and blisters, the whole time continuing to feign their illness.[281] It was a true contest of wills. On occasion the doctors dimmed the wits of the patients by administering anesthetics during their examinations. This tactic was considered to be of "utmost value" in deciding the "fortunes of a doubtful day," particularly in such difficult cases as deafness, blindness, rheumatism, paralysis and epilepsy.[282]

The doctors at Turner's Lane described in detail the many creative forms of malingering and the method by which they were detected by the expert doctors. Assistant Surgeon E. Dyer in charge of the eye and ear ward at Satterlee Hospital and a friend of Drs. Morehouse, Mitchell and Keen submitted a case report in which he caught a patient feigning blindness. The case was included in their publication because it was considered unique. The patient complained of "entire blindness in the right eye" but after an examination by ophthalmoscope revealed no lesion, he had to submit to a series of other tests:

> A prism being held before the right eye, the left eye being open, a pen was held up and the patient asked how many he saw. "Two." What is their relative position? "One is higher than the other." Sadly accurate. His perfect vision was proved, since he saw the pen with the left eye at the real elevation, and with the right eye at an imaginary one. The experiment was repeated with another prism of a different angle, and the result verified, the distance between the two pens only being altered. The prism being removed, the man saw that but one pen had been held up, and very obligingly played cards all afternoon with his left eye entirely closed by a bandage. The Army of the Potomac speedily received a reinforcement of one.[283]

Doctors were also taught to detect feigned lameness, which after close examination of the leg involved spying, removing any means of locomotion, having the patient walk to the mess hall for meals and taking away most privileges until the patient forgot himself and walked or moved around. DaCosta warned doctors that "the cane is apt to be put down after the leg instead of before, whereas a really lame man will always put the cane down

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[280] Ibid p. 371.
[281] Ibid.
[282] Ibid.
[283] Ibid. p 373.

first."[284] Some perceived illnesses, however, required more scientific expertise. Back pain, for example, was very difficult to determine. Patients often complained of "lame back," "weak back" or "kidney complaint," which occurred "by the dozens in the great hospitals." Most were associated with hard service or a result of disease and were accepted to be real, yet there were false cases that required "the most exact and scientific knowledge" to be revealed. Experience demonstrated that back pain often improved under the appropriate treatment; if it did not, depending on the severity of the case and symptoms, these cases generally got progressively worse. Malingerers never seemed to get better but never got any worse:

> These patients complain loudly of pain. They stoop in their gait and limp about by aid of sticks but they appear well nourished, devour their full ration of food and present none of the grave constitutional symptoms of the cachectic neuralgias we have considered. Nor are any of the symptoms of chronic rheumatism present. There is no deformity, swelling, stiffness, or immobility of the joints. These patients are more apt to attribute their malady to a strain than the genuine cases, and tell frequently a pitiful story. The experienced surgeon will very often detect them by this story alone; they wimper and even sob in an unmanly manner, which in itself alone should produce suspicion.[285]

Doctors were advised to call on their expertise and employ "every means of diagnosis" including a careful examination of the "case history and symptoms" and to "strictly examine" the body, the urine, constitutional symptoms and above all else carefully to track the progress of the case.[286]The investigations established a record of how to diagnose "true diseases" but also the signs associated with feigned diseases.[287]

The diseases most likely to be feigned were difficult to diagnose but once again physicians had an unprecedented opportunity to develop their diagnostic skills with patients who were trying to undermine them. Woodward pointed out that shirkers were "unmanly" and did not warrant the respect of physicians. The language and description of these cases supports the contempt for malingerers. Keen, Mitchell and Morehouse described a case in which Private F.W.W, Co. A 121st New York, feigned paralysis and lameness. He had received a gunshot wound of the left neck, which emerged near the

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[284] Keen, Addresses, p. 439.
[285] Woodward, pp. 324-5.
[286] Keen, Mitchell and Morehouse p. 378.
[287] Keen noted that the experience with malingering allowed a comprehensive record of the true symptoms of epilepsy, wounds of the spine, back-pain, kidney diseases etc. to be developed. It forced physicians to really understand nervous diseases so as to diagnose them properly.

spine. Keen, Mitchell and Morehouse determined that none of the important nerves had been injured but still the man complained of "stiffness and complete paralysis of the muscles of the neck."[288]Unaware to the patient, he had been observed moving his neck and was immediately congratulated on his improvement. But his shoulder was "incorrigible" and merely hung by his side paralyzed. The doctors used electricity to test the condition of his muscles but it was discovered that the muscles were being used when they were not present and were therefore likely not injured directly or by reflex action. To be sure they etherized him:

> He feigned admirably at first, the muscular relaxation of ether, and we thought him anesthesiated without result. But suspecting the double game, we carried the ether still further, and had, in five minutes, the pleasure of leaving his senses yawning and stretching himself the arms far above the shoulders, and every effort to move them down resisted by his deltoid. The movements were of course somewhat weaker than those of the other arm. He was sent to his regiment with a note on his descriptive list giving the facts as stated.[289]

Despite the potential problems associated with anesthesia, Keen argued that it was invaluable for detecting malingerers. He also used it for detecting deafness since during the recovery stage of ether the patient "becomes unaware and all of sudden can hear again."[290] Keen warned physicians that if patients were housed in a ward for a considerable time and had seen other patients etherized, they took to feigning both the disease and also the effects of complete anesthesia "long before it actually existed." He therefore recommended administering "a little extra dose, so that one is absolutely sure that the etherization is real and not imitated."[291]This use of anesthetics highlights the contradictory status of the physician in his wartime duties. On one hand, the use of anesthetics was part of the movement for humane surgery and the number of deaths was relatively low; on the other, doctors were aware of the potential dangers and patients with constitutional debilities might have succumbed to it. In cases of malingering it was used to render the patient insensible, which gave physicians tremendous power. They reasoned that if a man was indeed a malingerer he did not have the right to object. If however he

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[288] Ibid. p. 380.
[289] Ibid. pp. 380-81.
[290] Keen, *Addresses and Other Papers*, p. 438.
[291] Ibid. p. 430.

was truly ill, it was once more a situation in which the individual body was used to develop knowledge for the greater good.

The most original findings came in the experiments related to false epilepsy of which doctors had "a very large experience in the treatment of this malady." It was easy to simulate because of the wide range of symptoms. Keen, Mitchell and Morehouse found the disease even in its truest form difficult to diagnose, making it even harder to detect malingerers who were feigning the symptoms. The main challenges associated with the disease (both real and imagined) was the loss of "consciousness or of sensation" combined with the "undoubted existence of reflex actions," convulsive movements and the difficulty in examining the pupils. Most troubling was that "the endurance and persistency of many malingerers is such as almost to set at defiance all severe means."[292] Once again the physician needed superior skill effectively to distinguish malingerers from genuine patients. The doctors pointed out that due to the "want of mathematical certainly in nearly all tests, with this disease and all others…each surgeon must judge for himself, when the point is reached in individual cases at which it shall be conclusive."[293] They devised a series of tests that were almost completely original since the published literature on the subject had been so far "unreliable." First they monitored patients for months, trying to determine if the symptoms were genuine. They studied the face and mental condition and also considered character, case history and general health in the search for possible contradictions; they studied his "attacks" when he was alone and with visitors; and they looked for specific signs: Did he fall off the bed during his attacks or was he able to hold on? Did his pupils change during an attack? What did his pallor look like? During a spasm were his hands opened or closed (a malingerer tended to close his hands while an epileptic kept them open.) Ether was considered invaluable in these experiments and used in two ways:

> We have given it to supposed epileptics who were having successive spasms, with intervals of rest. Now when thoroughly given it will arrest the fits, but as the man revives he will often chance to have a fit while still so far anesthetized as to make it incredible that he should have arranged the phenomena by will. Here everything will depend on the experience and skill of the observer. If he be sure that the new fit preceded the return of consciousness, it is a genuine case.[294]

[292] Keen, Mitchell and Morehouse p. 385.
[293] Ibid.
[294] Ibid. p. 389.

Something they believed was unknown before their experiments was that with "persons who are liable to epilepsy the administration of ether or alcohol will bring on a fit." The record of their experiments reveals that those actually suffering epileptic fits had sometimes to sacrifice their care and treatment for physicians to study and learn from their bodies. But this produced "novel results":

> When ether is administered to a true epileptic case, its first effect is to increase the violence of the spasm, but eventually the patient passes into a deep ether sleep or coma, without of the usual cerebral excitement. He does not talk or laugh and goes directly from the state of convulsion into a profound comatose condition. The hyperaesthetic spinal system seems to respond alone to the stimulant power of the ether, while the cerebral centres do not. When the same test is applied to a false case, the patient presents all the usual effects of ether, talking laughing and acting his dreamed delusions in the ordinary way. When ether is used during the state of comatoid sleep which follows many fits, there is also an absence of all manifestations of excitement, and the sleep only becomes more intense.[295]

There were no comments about ethics or the rights of the patients in these experiments; just the opposite. The doctors observed that the ether test was "the most valuable and certain of all the means hitherto employed to unmask cases of feigned epilepsy."[296]Case L, for example, was described as follows:

> Having watched for the chance for over a week constantly it at last came. The fit was freely inaugurated with champing of the jaws, and violent struggles, especially in throwing his head back on the bed. In a previous fit in the guard house he was exceedingly careful to throw his head back only on the blanket, and his efforts manifestly declined the moment he had struggled on to the floor. The ether was administered carefully, giving considerable air with it, so that he should not be too suddenly etherized as he was breathing deeply and hurriedly from the great previous physical exertion. After a few inspirations the paroxysms, which had recommenced the moment the ether was applied lost their purposive character, and became violent struggles to tear the sponge away from his face, at the same time spasmodic deglutition and puffing respiration occurred, and in a few moments he began to cry out and laugh. He was sent to the guard house immediately and returned to duty the next morning with a note on the descriptive list, to the effect that he was a complete and remarkably good malingerer.[297]

Keen, Mitchell and Morehouse illustrated their findings with a number of cases. Some were genuine epilepsy, others feigned, but in both classes patients underwent similar tests. The team etherized patients before, during and after fits and kept detailed notes on

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[295] Ibid.
[296] Ibid. p. 390.
[297] Ibid. p. 392. Case L, May 8, 1864.

how they responded. This was an important contribution to the medical profession's knowledge of malingering but also the true symptoms of nervous diseases which resulted from "opportunities such have been rarely presented." They published their observations and the results of their experiments as a guide for other physicians.

The themes of death, contests over the body and scientific medicine intertwined in interesting and important ways in the Civil War. The body and the physician were now inextricably linked as doctors worked to repair the damages of war. Troops were exposed to never before seen diseases, which altered the body and paved the way for the medical department's access. Civil War weaponry also destroyed the body, but physicians promised to heal the wounds and thereby earned access to specimens and bodies. At great human cost the medical profession benefited from the connection between disease, war and the body. They doctored in the war to preserve the health of the republic but it was also an important period of training and professionalization for orthodox physicians. The diseases that ravaged soldiers' bodies shaped the projects and directed the specific aspects of scientific medicine; but often the individual soldier had to relinquish ownership of his body for this knowledge to be developed. Soldiers were asked to give up their "bones for the good of the country" and for other soldiers who would benefit from the knowledge generated from the individual body. All this developed in relation to the changing attitudes about death and dissections during the war. Physicians were an important part of this process, both a cause and beneficiary of this larger shift. Circular No. 2 provided for the Army Medical Museum, which was filled with military bodies. Dissection had been conducted prior to the war but this was a National Cabinet "unsurpassed" anywhere in the world and promised American medical supremacy and scientific progress. The idea of scientific development appealed to the public in the third quarter of the nineteenth-century and they flocked to see the collection. The physicians who dissected bodies, prepared specimens, microscopic material and produced complicated case histories based on an intimate knowledge of the body were framed and were thus seen as experts. In describing the content of the museum Woodward wrote:

To give any detailed description of such a collection is of course out the question; yet it may be of interest to state there are upon the shelves 2211 specimens of fracture of the cranium including 46 cases of trephining; 10 of depressed fracture of the inner table, without injury of the outer, a rare and interesting condition on which it would be out of place to comment here; 22 specimens of wound by sabers and other cutting weapons.[298]

He went onto discuss the other divisions of the museum—but these were merely general descriptions accessible to the lay person to draw them to the museum. The public did not understand details because the scientific medicine being produced at the museum was too complicated for anyone but trained professionals. Physicians worked hard during the war to gain this status: they collected specimens, dissected bodies, submitted case notes and their research findings. They published the results of their work in numerous medical journals, contributed to the *Medical and Surgical History* and even published in popular magazines like *Lippincotts* to ensure that the public was aware of their labors. Many physicians began speaking in scientifically structured rhetoric, reducing patients to their most valuable body parts—which were packed up and sent to the museum with a case history. But not all soldiers wanted to relinquish the ownership of their bodies and thus feigned diseases which challenged both the Army Medical Department's ownership of bodies and also their skill. In response physicians policed the body in a variety of ways and exercised their ultimate power through anesthetics, rendering the patient insensible so that his body could be investigated. As argued here, through the ownership of military bodies established by the medical department, physicians were able to learn both from the living and the dead body. The war allowed, even demanded, the acquisition of specimens and bodies and in doing so altered perceptions of the body—how disease functioned within it, what diseases looked like and the different ways the body could be studied to develop knowledge. The history of the wartime bodies, captured in case records and specimen histories, tells many different stories but the underlying commonality is that physicians formed a professional identity through this access. Wartime work created an intellectual divide or hierarchy of knowledge among those physicians that responded to the medical opportunities presented by the war and superior practical and epistemological standards for American and even world medicine.

[298] Woodward, *Lippincotts*, p. 235.

Chapter Five:
Post War Syndrome: Cholera and the Civil War Medical Model in the Post-War Period:

In 1871 the physician Joseph Woodward observed that the "science of medicine is essentially progressive: with increasing knowledge comes more subtle skill, and the advances already made warrant hopefulness as to the future."[1] He also remarked that on-going improvements in medicine were accompanied by "continual changes in medical language, and it would be easy to quote cases of comparatively recent date in which the introduction of a new term was followed by a most unfortunate confusion of ideas."[2] He observed, however, that the collection of specimens during the war provided an unprecedented experience for physicians to learn, study and practice medicine and as a result speak in a common language. The common language that Woodward spoke of was the language of science. The war physicians were part of a shared experience: the collection and study of specimens, the mandatory case report, publications based on their wartime experiments and newfound knowledge, which reflected a deeper understanding of anatomy, physiology, biology, disease and the human body. This commonality supported the development of a distinctive American medical identity, a large part of which was rooted in wartime medicine. As Woodward observed, "it has long been a subject of complaint among American investigators that their labors have been ignored, or that at best their practical deductions have been used without acknowledgment by European scientists."[3] The wartime work, however, enabled American physicians to contribute to the production of medical knowledge in unique and often unprecedented ways since many of the diseases, treatments, experiments and results encountered during the war were novel.

As argued in earlier chapters, in accounting for the development of the medical sciences in America, there has been far too much emphasis on the shift in migration from Paris to Germany and not enough on what was happening in America, specifically during

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[1] Joseph Woodward, "The Army Medical Museum" *Lippincott's Magazine of Popular Literature and Science* Vol. VII (March 1871): 233-242. p.233.

[2] Ibid. p. 241.

[3] Ibid. p. 242. The historian Dale Smith illustrates this problem quite nicely in his paper on Gerhard in which he demonstrates that the British medical profession refused, for a variety of reasons, to acknowledge Gerhard's milestone in his distinction of typhus from typhoid fever. See Dale Smith, "Gerhard's Distinction between Typhoid and Typhus and its Reception in America, 1833-1860." *BHM* (1980): 368-385.

the Civil War years. For example John Harley Warner in discussing the "conversion of sick people into objects of science" has suggested that while "Americans had long spoken of human cadavers as "material," it was with the shift in migration from France to Germany that they fell into the habit of using this term to refer to living patients as well."[4] This was a very important shift in accounting for the development of scientific medicine because it suggests a new belief in experimental method—but this did not develop solely with the German influence. The importance of research on the living and the dead was an ideal that developed during and in relation to some of the medical challenges of the war. Both dead bodies and living patients were referred to as "material" or "specimens" and it was from these bodies that knowledge was produced to benefit the soldiers still alive and fighting to preserve the Union. Woodward, for example, routinely harvested material from the specimens submitted to the museum in order to produce a microscopic cabinet displaying the minute aspects of disease processes. On the other hand Keen, Mitchell and Morehouse conducted experiments on the living at Turner's Lane Hospital and often referred to these patients as valuable research subjects and an important source of medical knowledge. Regarding patients as "material" became quite common during the war because, as already suggested, Circular No. 2 practically demanded that bodies be reduced to their most useful parts—the parts that could reveal the mysteries of disease and thus drive medicine forward. Physicians studied, dissected, rendered insensible, conducted experiments on the living and the dead and framed their work as beneficial for the soldiers still alive, which well suited American physicians who often objected to the way patients were seemingly exploited in Paris and Germany.[5]

Wartime medicine encouraged physicians to see beyond the patient with a view towards the knowledge that could be gleaned from the body. The wartime medical model provided an acceptable context for experimentation and thus provided an important educational intervention for many physicians. It is also significant that the Army Medical Museum supported the development of these various research objectives. The AMM was an institution that could support experimental method and showcase the results to American physicians. Whether it was a new specialty such as reconstructive surgery or

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[4] John Harley Warner, *Against the Spirit of the System*, p. 304.
[5] Ibid.

pathological specialism, doctors could now see the efficacy and intricacies of scientific medicine but also the potential benefit of becoming acquainted with these newer methodologies first hand. Many physicians felt compelled to continue or complete their education with bodies, specimens, investigative tools and specialized study and thus traveled to Germany in the postwar period.[6]But the Surgeon General's Library, which developed out of the same impetus and needs as the museum, also facilitated the development of scientific medicine in America. These repositories provided important support for the dissemination of the wartime knowledge and the new research ethic in American medicine.[7]

Historians agree that enthusiasts of scientific medicine were influential in articulating its benefits in the post-Civil War period but accounting for this shift is more complex than previously claimed. One effect of medical practice during the war was that science came to assume a new role in medicine for both the elite and the rank and file. But how did this translate into acceptance for scientific medicine as a new medical model in America? As suggested, the Civil War years saw a new emphasis on scientific medicine and the "advances"[8] during the war set new epistemological standards in American medicine. This chapter demonstrates how the medical model developed during the war led to a pattern of recording events, experiences, challenges, research ideas, problems and the transmission of this knowledge. Both the systematic record keeping required by the Union Medical Department and the encouragement of scientific production during the war had an important effect. For example, if doctors were experimenting or having success with a particular treatment, they were asked to submit evidence to the Surgeon General who would then order further trial if warranted. The idea

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[6] For example, Keen noted that "late in 1864, seeing that the war was almost over, I sailed for Europe" he "studied in Paris" and in May 1865 "settled in Vienna for spring term" and then went to "London to see a bit of English surgery."By 1866 he was back in America as head of the Philadelphia School of Anatomy. See, Keen, *Reminiscences*, APS (BK45) pp. 34-40. He is a nice example of the many different educational opportunities that physicians sought in the 19th century—and the war was a central part of his professional development.

[7] These are the very tangible results of the war and can easily be linked with the development of scientific medicine in America. The harder story to elucidate is the changing attitudes of the physicians' and how that contributed to the development of scientific medicine in America. The institutional support is important, but this chapter is concerned with how attitudes about scientific medicine changed as a result of the war experience, or the experience with military bodies and diseases.

[8] The advances in medicine made during the war were the subject of Woodward's article. He had two agendas in writing this article. The first was to encourage Congress to continue to fund the work at the museum; the other related goal was to encourage the public to visit the museum so that the scientific work of the physician could be viewed by the public. See, Joseph Woodward, "The Army Medical Museum" *Lippincott's Magazine of Popular Literature and Science* Vol. VII (March 1871): 233-242.

was to cooperate in order to preserve and/or restore the health of the troops but also to promote professional growth. As argued, no revolutionary cures for medicine were discovered but there were advances in how ideas were constructed, how medicine was studied and the creation of new networks of knowledge, which translated into the development of science in medicine. This new reverence for scientific medicine was illustrated in a variety of ways in the post war period. Through an examination of the military's response to the 1866-7 cholera outbreaks, this chapter demonstrates how some of the practices, principles and patterns that were developed to manage disease during the Civil War were adapted in the post war period. These new methodologies became institutionalized and found further support for their development. Finally, some medical professionals discovered a powerful medical identity through their wartime work and found themselves arbiters of scientific knowledge in the post war period. The chapter concludes with a very brief examination of the Toner Lectures designed for the "advancement of medical science," and some of the professional relationships that developed during the war and continued to evolve afterwards.

Research and Investigative Medicine:

It might be a stretch to compare the research initiatives during the Civil War to an independent research institute such as the Rockefeller Institute established in 1901 for "a handful of individuals possessed with the spirit of inquiry and with the ability and training and brains to successfully explore their problems....and to cherish these men and give them the resources and opportunity they need."[9] But during the war, those physicians with the "spirit of inquiry" were similarly encouraged to explore the problems they encountered —whether related to neurological disorders, reconstructive surgery, heart disease, pathological specialism or the investigations into specific diseases. Further physicians were also recognized for their contribution to the medical sciences: for example, as demonstrated in chapter 2, Frank Hinkle's experiments with permanganate of potassa confirmed its potential for treating hospital gangrene; as a result of his report to Hammond the latter promptly ordered the manufacture of the compound for the supply table;[10]perhaps most importantly, his discoveries were published in the *Medical and*

[9] The Rockefeller Institutes Formula as quoted in Marks, pp. 48-49.
[10] Please see Chapter 2.

Surgical History of the War and *Circular No. 6.* In his study of American medical education, William Rothstein argues that a "large number of medical journals contributed to the growing professionalism of medicine" and that between 1797 and 1857, 178 medical journals were founded, 135 after 1832."[11]There were up to seven hundred subscribers, but only 30 of the 178 journals survived to 1857.[12]Most of the journals republished articles from European journals and did little to "advance or promulgate medical knowledge" in America.[13]But the medical department created a structure by which knowledge could be produced and also transmitted through the many publications of the Surgeon General's Office. While research was not strictly institutionalized in universities, medical schools and research laboratories, physicians such as Hinkle, Keen, Mitchell and others who were often perplexed by the medical challenges they encountered during the war, undertook specific research questions to help answer both their own inquiries and those generated among other physicians in America and Europe; and they found support for these initiatives. The research during the war supported developing objectives about scientific medicine in the third quarter of the nineteenth-century and in that environment more physicians than ever saw the value of cultivating diversity in medical study and practice.

There was a range of ideas about disease that developed within this framework: How did disease spread? How could disease best be managed? How should diseases be investigated? How should this knowledge be transmitted? Many physicians worked together on these questions during the war, consulting with each other, publishing and reading the experiences of their peers and organizing meetings and lectures. In other words, as the physicians themselves responded to the medical challenges of the war they created and fostered an environment in which they were professionally stimulated. A generational consciousness developed through the common experience which they lived, which extended to the way in which both projects were formed and the way in which physicians worked together to master the problems of the war. The structure erected by the medical department supported the development of collective investigation: physicians

[11] William Rothstein, *American Medical Schools and the Practice of Medicine: A History* (New York: Oxford University Press, 1987) p. 42.
[12] Ibid.
[13] Ibid.

investigated disease or conducted their own experiments and submitted reports to the medical department or medical journals and the body of medical knowledge that was developed was used to create knowledge that was *practically* beneficial. Physicians developed both identity and confidence through this larger association or affiliation, which became more powerful as the war continued. Individual industry could develop within a larger infrastructure; and this was evident once again in the cholera investigations in 1866-67.

Charles E. Rosenberg begins his examination of the 1866 cholera outbreak with the chapter heading "America after the War" and does therefore not examine the war or the development of the individual physician as a result of the war. He focuses instead on the growth of cities and industry and the concomitant challenges to public health, the spiritual dangers of the rapid progress that characterized America after the war, the rise of immigration and the development of the metropolitan board of health.[14]He suggests that "the medical profession was in transition in 1866…while medical science had already entered an age of heroic achievement, the practitioner of medicine still occupied much the same lowly status he had in 1849."[15]He further argues that science did little to help in the management of the 1866 outbreak and that the only real contribution was the "sanitary and hygienic regulations" that medicine helped institute.[16] He neglects, however, to examine the military's response to the management of cholera. It is important to state here that the way in which military physicians managed the outbreak *was very scientific to them.* The case reports demonstrate that there was a range of disease theories about cholera, and it was passionately debated whether the disease was transmitted through water or air, caused by a poison of unknown origin or directly contagious. The uncertainty and fear regarding cholera encouraged numerous experiments with various remedies, the development of epidemiological science, preventative medicine and once again autopsies were routinely performed as a matter of professional interest. An examination of the military's response to and management of cholera helps elucidate more clearly what science meant to physicians in the third quarter of the nineteenth-

[14] Charles E. Rosenberg, *The Cholera Years: The United States in 1832, 1849, 1866* (Chicago: The University of Chicago Press, 1962).
[15] Ibid. p. 214.
[16] Ibid. I would also suggest here that many of the sanitary and hygienic regulations were instituted *because* of the knowledge produced using scientific methodologies.

century and also the way in which knowledge was produced regarding disease in the post-war period.

The measures adopted by military physicians were far more complex than has previously been advanced. This study disagrees with Rosenberg's contention that the members of the regular medical profession were ineffective and even a "hindrance to the progress of human knowledge."[17]They engaged in experimental medicine and knowledge was generated, recorded and studied about the specifics of this disease, and these investigations were important in establishing a foundation for the study and practice of medicine in the final third of the century. Indeed practical innovations in managing disease such as experimental remedies and preventative medicine (e.g. as in gangrene and erysipelas) gave new meaning to science in the practice of medicine. However, because the contracts of so many volunteer physicians ended with the war, there is a new dimension to consider: the importance of the cross influences of civil and military medicine in both managing disease and developing medicine in the post-war period. The practice of medicine was still very open in the third-quarter of the nineteenth-century and there was no sharp divide between civil and military physicians; but like the wartime medical environment, there were many consultations and the sharing of information was routine. As discussed later, these relationships are crucial in understanding the development of scientific medicine in America.

In his excellent study of disease theories in the nineteenth century, Michael Worboys argues that "for sanitarians, cholera had been the model miasmatic disease."[18] Cholera had originated in India "its poison spread several times to Europe" and it was thought to be "either a gaseous poison traveling on air currents or an immaterial influence that, when settling in particular areas, induced decaying vegetable matter in the soil to elaborate poisonous "cholera stuff."[19]By the second half of the nineteenth century,

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[17] Ibid. p. 224. He makes this claim because of their unwillingness to work with sectarians, but as demonstrated above it was a clear objective of the regulars to orient medicine along the lines of scientific medicine—an ideal which sectarians did not fit. An important feature of the war was that it enabled the regulars to take a sort of ownership over medicine and this was once again reinforced during the cholera outbreak. In hindsight, yes sectarians may have been effective but for the regulars, especially in the military, they did not want to relinquish the ground they had won in regard to this battle. The really important point is that they do not see themselves as a hindrance-they see themselves as moving medicine forward.
[18] Michael Worboys, *Spreading Germs: Disease Theories and Medical Practice in Britain, 1865-1900* (Cambridge University Press: Cambridge, 2000) p. 113. See also, Rosenberg for theories of causation.
[19] Ibid.

physicians understood that cholera spread in overcrowded and filthy conditions and had been difficult to contain with quarantines.[20]The major attempt in managing the disease during the 1840s was through preventative measures such as cleanliness and sanitation. Advances in theories of disease suggested that cholera was in fact caused by a specific poison, but Rosenberg demonstrates, that there was still a powerful belief in the idea that those who became ill with the disease were "slum dwellers" living in filth and therefore deserved to catch the disease.[21]However, customary belief was challenged in 1866 as the disease once again made its way through America. Rosenberg suggests that in the history of public health there is "no date more important than 1866"; part of this was due to the organization of the Metropolitan Board of Health where for the "first time, an American community had successfully organized itself to conquer an epidemic."[22]There were changing attitudes regarding disease management but these attitudes can in part be traced to some of the methods and concepts developed during the war and as a result of the work done regarding some of the pervasive diseases that physicians then encountered. As demonstrated in the investigations related to gangrene and erysipelas, septic diseases were beginning to be associated with some sort of body to body contagion which was amply demonstrated in the Civil War hospitals, and physicians increasingly associated "germs" or "contagions" as the cause of the extensive tissue damage. But cholera was different; it had always been associated with a "poison" in the atmosphere and its etiology was little understood. Like the experiences with gangrene and erysipelas, cholera in 1866-67 complicated traditional ideas about disease.

In considering how ideas related to cholera were constructed and transmitted in the final third of the nineteenth century, it is important to consider both civilian and military influences. The physicians at the Army Medical Museum were uniquely qualified to contribute to the medical understanding and management of cholera because of the various locales in which soldiers were stationed; once again they had the resources to marshal information from physicians in the field. The timing of this epidemic was important for further institutionalizing some of the wartime reforms. Many leading

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[20] Ibid.

[21] Rosenberg, p. 150. There is an important class/racial dimension to this disease. It was always associated with lower class, crowded tenements and even within the military it was associated with intemperance, poor personal habits disobeying sanitary regulations. These older views are still prevalent in some of the case reports.

[22] Ibid. p. 193.

members of local public health boards were greatly influenced by the work of the Sanitary Commission during the war.[23]There was also a continuation of ideology or past aims among some of the elite that had doctored in the war. Some of the physicians mentioned in this study such as Frank Hamilton, J.H Cuyler, Agnew, and Stille, served on the board of American Association for the Relief of Misery on the Battlefield (1866) and continued working toward the development of public health reform.[24]Even more important, the control over medicine that the military had exhibited during the war was once again instituted to manage cholera in 1866-7. Many states enacted legislation establishing and regulating quarantines for the protection of the states; these generally operated with the civil board of health but were often controlled by the military.[25] In this case to prevent cholera from entering the United States:[26]

> Well grounded apprehensions of the appearance of Asiatic cholera as an epidemic early in the present fiscal year (which began July 1, 1865) required prompt action for the protection of our troops. A rigid military quarantine was established on the southern Atlantic Coast and sanitary precautions enforced. The adoption of these measures availed to control or eradicate the disease at the recruiting depots and forts where it appeared before it assumed its usual alarming epidemic form; and official recognition has been given to the meritorious services of medical officers' whole fidelity, energy, and skillful administration succeeded in averting or diminishing the horrors of widespread pestilence.[27]

The federal government had a record of experience in investigating disease, control and the infrastructure in place to construct a research program or contribute knowledge on disease management. Furthermore, the medical department still assumed ownership of military bodies and could thus advance knowledge about the etiology of the disease through post-mortem exams, which were routinely performed in the

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[23] See, William Quentin Maxwell, *Lincoln's Fifth Wheel* (Longmans, Green and Co. New York, 1956)

[24] Maxwell, p. 288. Individual physicians were fine to move between a hospital position and work for the sanitary commission but the higher ups such as Barnes were often jealous and petty and felt scientific inquiry should be the exclusive domain of the medical department.

[25] See letter "Relative to Quarantine" from Bvt. Brig. General J.J. Milhau, Surgeon USA Medical Director 3rd Military District Atlanta Georgia. RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. He discusses here the medical director of the army becoming president of the board of health. General Order No. 43, Medical Department of Louisiana, May 15, 1866 appointed medical officers to quarantine duty. Military quarantines existed also in the Carolinas, Florida, Texas, Indiana and the military was found effective in maintaining quarantines. The military did this to both protect the states but also the "sanitary protection of the military force."

[26] Ibid. General Order No. 3 Headquarters, Second Military District, Charleston SC, March 24, 1864 established quarantine for all vessels-which carried on into 1866.

[27] Joseph Barnes, Surgeon General to Hon E.M. Stanton, Secretary of War. In Annual Report of the Secretary of War for 1865." Quoted in Alfred Bollet, p. 286.

investigations into cholera. The chief goal, however, was to construct an epidemiological picture of the disease: how and where it originated, how it spread through the posts and how it could best be managed, all of which translated into public health policy. Joseph Barnes furnished many of the military records to public health officials concerning cases of cholera that occurred at the military posts on Governor's Island, Hart's Island, Davis Island and others in New York harbor. The results were then tabulated so that a comparison could be made with the records of the state boards of health. It was publicly claimed that "the record affords new and convincing evidence of the value of that ceaseless vigilance by medical officers which is seldom perfect excepting under military authority."[28]The military medical department invoked the well tested system of producing knowledge: circulars were issued to collect information about the disease from medical officers in the field, the knowledge was then analyzed, statistics were tabulated and another circular was sent out "for the information and guidance of all medical officers."[29]

Joseph Woodward was in charge of constructing an epidemiological picture of cholera and received numerous inquiries from state boards of health asking his advice about where and how cholera traveled through the country. For example, Elisha Harris, a member of the Council of Hygiene in New York (1864), (who wrote a scathing report about the sanitary conditions in New York)[30]requested a summary of the "facts regarding Asiatic cholera and diarrheal diseases at the military posts in New York harbor in 1867."[31] Woodward discussed the posts in which cholera had occurred, the date of the first recorded case and in detail its spread—where the infected person traveled, his symptoms and if cholera was spread from person to person from this first infected case.[32]The medical department was in a unique position to amass information because of the improving transportation systems after the war, the movement of the military and the number of military posts made the transmission of the disease more likely but also

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[28] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. From a newspaper clipping simply entitled "The Public Health" located in Box One.

[29] See for example Circular No. 5, Washington DC May 4, 1867, an analysis of the 1866 cholera outbreak for the information and education of medical officers. RG 112(NARA) Central Office Issuances and Forms: Circulars and Circular Letters, Letters of the Surgeon General's Office, 1861-1885.

[30] For more on Harris as a sanitary reformer see Rosenberg, pp. 187-191.

[31] Woodward's Letterbooks Otis Historical Archives RG 28 (NMHM). Letter to Elisha Harris from Woodward, Jan. 14, 1867.

[32] Ibid.

traceable. To help compile information about the disease, Woodward issued a circular letter to the surgeons in charge of the general hospitals asking for a report detailing "the number of cases which originated in your hospitals" and whether the "first cases of cholera occurred among the recruits or other infected patients."[33] The first report, Circular No. 5, concerned the cholera outbreak during the last six months of 1866. The second report, Circular No. 1, concerned cholera and yellow fever in the Army of the United States during the Year 1867.

But how was cholera understood by American physicians? Debates around causation had existed since cholera made its first appearance in the 1830s. Anticontagionists believed in the existence of decomposing organic matter called miasma that would thrive in certain atmospheric conditions including filth, and a person with a constitutional predisposition was at greatest risk. Usually some kind of noxious effluvia would be exhaled and then inhaled through the lungs entering the blood, disrupting the physiological balance and a new case of disease would develop in someone with a predisposition.[34]Contagionists on the other hand believed that the disease causing matter was produced in the bodies of sick people, transmitted by exhalations and inhaled by healthy people who then became sick (thus traceable to human contact). Many nineteenth-century physicians were contingent contagionists and wrestled with the evidence of the cases with which they were confronted. This group generally believed that the disease might or might not be contagious and was dependent on factors such as individual susceptibility, habits, filth, weather, diet and the virulence of the virus. The one commonality shared by most physicians was the belief that cholera was contracted through inhalation. But there was increasing support for ideas related to contagion, which would support emerging bacteriological science. As will be demonstrated, most case reports suggested the disease was traceable in some way to human contact; medical attendants were believed to be at risk of contracting the disease and some physicians believed that the disease was imported from an infected to a healthy locality. But as exhibited in the investigations related to gangrene and erysipelas and which will be seen again with the cholera case histories, there was much over-lap among the three theories.

[33] Woodward's Letterbooks Otis Historical Archives RG 28 (NMHM). Dec. 5, 1866.
[34] The idea of predisposition is important—it is mentioned in a number of case reports.

Both traditional and new ideas were constantly debated during this period of medical development.

Since its first appearance in the 1830s, cholera was generally thought to be a non-specific miasmatic "filth-disease." In 1849 John Snow challenged the consensus by arguing that cholera was a contagious, specific, water borne disease. Five years later he confirmed his contention in two separate epidemiological studies into the mode of transmission, confirming that cholera was spread by contaminated water.[35]But were the views of John Snow or the Bavarian scientist Max Von Pettenkofer, who also published on the dangers of a contaminated water supply, understood and accepted by American physicians? Rosenberg argues that "when in the spring of 1866, the United States was again threatened by cholera; these ideas had been current in medical circles for a decade and were widely accepted by American physicians."[36]But were they really *widely* accepted? Some historians have suggested, "At Snow's death in 1858, few people working in public health and sanitation believed his theory of the cause and transmission of cholera."[37] Many physicians that were charged with managing cholera in 1866 and 1867 had not been responsible for it in 1849 or 1855. In fact, a number of physicians had only read the published experiences of European and American physicians and did not have their own practical experience with the disease. This is a crucial point in the present study of the development of scientific medicine in America. Reading journals and becoming intellectually apprised of newer modes of investigation was only one part of American medical development. The lack of structure and lax medical standards of antebellum America often meant that only the elite were engaged in hospital work or medical research but practical experience in Civil War hospitals combined with the structure for stimulating investigative medicine and disseminating the knowledge was

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[35] Margaret Pelling, *Cholera, Fever and English Medicine*, 1825-1865. (Oxford: Oxford University Press, 1978). See also Rosenberg, pp. 193-194. It was spread through the excreta and vomitus of cholera patients leading to contaminated water supplies and demands for sanitary reforms.

[36] Rosenberg, pp. 194-195. In a sampling of 128 physicians, Rosenberg cites 55 as being "thoroughly contagionist"; 21 were considered "contingent contagionist"; 52 were anticontagionists and 45 accepted some of the conclusions of Snow and Pettenkofer. From 1855-1866 doctors were reading European medical journals and had up to date medical knowledge—but in 1866 some physicians had never seen, treated, or managed cholera. They lacked practical experience. Thus understanding how theories were debated, developed and understood elucidates physician development in the 19th century.

[37] See, Peter Vinten Johansen, Howard Brody, Nigel Paneth, Steven Rachman, Michael Rip, *Cholera, Chloroform and the Science of Medicine: A Life of John Snow* (Oxford University Press, Oxford, 2003) p. 392. It was not until 1866 that his ideas began to be really accepted and experimented with as physicians attempted to manage the disease.

transformative for both the rank and file and the elite. Indeed, the most important shift related to the physicians themselves: how they studied and managed medicine; the equipment they used to investigate disease; and of course the transmission of this knowledge among practitioners. A significant finding of this study is that American physicians wanted to continue or become producers of medical knowledge and were no longer content to merely rely on the results of European physicians. Silas Weir Mitchell suggested that one of his physiology lectures in the 1850s was "a more or less well stated resume` of the best foreign books, without experiments or striking illustrations. It was like hearing about a foreign land which we were forbidden to enter."[38]The networks of knowledge created during the war, however, provided a foundation for further scientific development at home and Americans had no desire to look back. In roughly the same period some English physicians, such as John Simon, wanted to conduct chemical and microscopial examinations on the morbid processes of cholera but could not since between 1855 and 1866 "cholera was absent from England, and no material was available for experiment."[39]Thus experiments that could elucidate the etiology of cholera were not resumed until the 1860s in England and this was also the case in America. Physicians were aware of the European developments regarding cholera in the 1840s and 1850s but this only went so far. American physicians liked to see the disease and make recommendations on its etiology based on their own findings and experiences.[40]

It was actually a very complex medical environment characterized by a multitude of disease theories and newer versus older modes of organization (although the measures were often the same quarantines, disinfection etc.) However, the reasoning for adopting these measures of control were in flux. For example, was the disease threat environmental or was it human to human transmission? The development of practical applications of scientific medicine into disease management provides an important insight into the culture of medicine in the third-quarter of the nineteenth century. Through both the war and the cholera outbreak of 1866 and 1867, such traditional measures to manage disease

[38] Silas Weir Mitchell as quoted in John Harley Warner, "Physiology" in *The Education of American Physicians: Historical Essays* (ed.) Ronald L. Numbers (Berkley: University of California Press, 1980) p. 58
[39] Pelling, p. 236.
[40] This point is commented on frequently in case reports. Physicians often point out how their findings may have differed from or enhanced the findings of European physicians—it is actually part of the American identity that we see develop through the war.

threats as disinfection and quarantine were still used but they were no longer merely driven by "filth" theories of disease; rather scientific medicine influenced many of the measures taken. These newer modes of organization supported emerging work in bacteriological science, which by century's end helped shape and clarify the way in which disease was managed in the second half of the century. By 1866 physicians increasingly debated, tested, experimented, even heartily supported Snow's theories; but it is not just the various theories related to cholera in the nineteenth century[41] that is of interest here but rather *how* these disease theories were developed. What was deemed important? What types of questions were the physicians asking? How was disease investigated? How was knowledge produced? In other words, how was scientific medicine developed?

The focus of research shifted from the wartime challenges to public health issues and other related disease threats but the methodologies used during the war were adapted to work in the post war period. Like gangrene and erysipelas, cholera posed a serious problem to Americans. The nature of the disease added to the fear and even desperation. William Bynum describes its manifestation as follows: "victims would be well in the morning and by nightfall, dying after a few hours of intense vomiting, diarrhea, cramps, clamminess and shrunken features."[42]After contracting the disease, victims were generally dead within forty-eight hours and the dramatic dehydration that characterized the disease "gave the skin an ominous bluish tint and the new corpses seemed to decompose more rapidly than normal."[43]One of the worst symptoms, which was commented on frequently in the case reports was the severe diarrhea, which took the form of "rice water stools" and was often so intense that patients would collapse before physicians could have any effect. Because of the fear and risk of treating this disease, Woodward asked that any physician that distinguished "themselves by faithful attendance to cholera patients" be brought to his attention so that they could be properly compensated.[44] The case reports reveal that there were four specific areas of interest:

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[41] For the very best study on theories related to cholera in the 19th century see, Margaret Pelling, *Cholera, Fever and English Medicine*, 1825-1865 (Oxford: Oxford University Press, 1978).
[42] William Bynum, *Science in the Practice of Medicine in the Nineteenth Century* (Cambridge University Press, Cambridge, 1994) pp. 74-75.
[43] Ibid. p. 75.
[44]RG 112 (NARA) Circulars and Circular Letters of the Surgeon General's Office" Entry 63, Circular No. 5, issued January 4th, 1867. This is an interesting point because one of the tenets of contagionist theory was that medical

identifying the specific agent causing the disease, creating a picture of the symptoms and pathology, the most efficacious treatment of the disease (of which there was little uniformity) and most importantly, was to determine the mode of transmission.[45]But modes of transmission were still under debate and proved challenging for many physicians. They were, however, developing a comprehensive picture of cholera, and contagion by some form of human interaction was increasingly targeted.[46]

There was a great fear that certain situations, particularly crowding among recruits during movement and at their posts, would promote the spread of disease. Any case that developed was reported to Joseph Barnes or Woodward and they initiated the process of tracing its origin. For example, Bvt. Major R.B. Browne Assistant Surgeon, US Post Hospital Galveston, Texas reported to Barnes:

> The cholera introduced among the troops stationed at this post by the arrival of detachment of unassigned recruits from Harts Island New York on the 22nd as reported last month in the report of sick and wounded has apparently died out as no new cases of cholera has exhibited itself among the troops or citizens of Galveston since the 24th. The post of Galveston Texas may be therefore considered at this time as perfectly healthy and entirely free from all infectious or contagious diseases.[47]

The term "infectious" (indirect) and "contagious" (direct) suggests worry about person to person transmission but there were also many unfamiliar patterns about its spread that puzzled some physicians. Medical Director Jos. R. Smith, 4th Military District in Vicksburg submitted a report to Barnes on April 19, 1867 detailing the mode of transmission and introduction of cholera to Little Rock and Helena in August and Huntersville in September, 1866.[48]Little Rock and Huntersville were only separated by the Arkansas River and were connected by a pontoon bridge, stretched between the two

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attendants often contract the disease—Woodward was not a contagionist (and was criticized for it) but it shows the uncertainty about previously accepted doctrines during this period.

[45] Cholera is transmitted through the ingestion of water contaminated with the cholera bacteria or by soiled bedding and clothing. Cholera patients suffered very liquid diarrhoea which often made its way into waterways, groundwater or drinking water supplies. It has generally not been associated with direct human to human contact; however, a 2002 study at Tufts University recently demonstrated the potential for human to human transmission see Merrell, DS; Butler, SM; Qadri, F; Dolganov, NA; Alam, A; Cohen, MB; Calderwood, SB; Schoolnik, "Host-induced epidemic spread of the cholera bacterium." *Nature* 417 (6889) (Jun 2002): 642–645. But the bacteria of cholera has long been studied in the laboratory as an evolving disease form.

[46] Although the idea of the disease developing within the body, vulnerable body, still dominated in most case reports

[47] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. Report submitted by R.B. Browne to Barnes, August 1866.

[48] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. Report to Barnes from Jos. R. Smith, Medical Directors Office 4th Military District, Vicksburg, Miss. April 19, 1867.

banks the greater part of September, 1866. Smith suggested that "constant communication existed between infected points on the Mississippi River and Little Rock by steamboat and railroad during the whole summer of 1866, but careful inquiry has failed to discover the particular case, if any, by which the disease was introduced."[49] In this particular situation the constant movement of these boats was very problematic:

> During the latter part of August scarcely a boat arrived at Little Rock, on which rumor did not affirm cases of cholera to have occurred. Many of these boats I visited in person to see such cases if there. In no instance did I find a case of cholera though on several boats, cases of disease had occurred (followed by death) during the trip from Memphis to Little Rock, which from their description I was satisfied were cholera. No cases of cholera that I could ascertain were seen by any physician of Little Rock or Huntersville prior to the first case officially reported as occurring at the Little Rock arsenal. In June recruits arrived at Little Rock from Carlisle. Detachments also passed through Little Rock in July and August. The points whence these troops came I am endeavoring to ascertain.[50]

Physicians often traced the disease between locales and tried to gauge common characteristics about its pathology and transmission. The physician E.M. Milhau, for example, wrote to Barnes from Fort Delaware in December of 1866, that he had tried to trace the origins of the cholera but was perplexed about its spread. He noticed that during the spring and early summer months, "intermittent and other fevers were unusually prevalent" upon the banks of the Delaware river and continued until early in the month of August when an "isolated case of epidemic cholera made its appearance."[51]He was puzzled that the usual cause of the disease in "ascending the banks of the rivers was not observed in the occurrence of this epidemic."[52]Rather, its first appearance was reported in an isolated case that occurred July 22 at New Castle Delaware in an "aged resident in town." The disease continued to spread and was reported as an epidemic in Delaware City, a small town at the eastern terminus of the Chesapeake and Delaware canal and ten miles down-stream from New Castle. The disease was confined to the "lowest class of the community" and not arrested until about the 20th of September by which time it had become epidemic in New Castle the point first visited."[53]He isolated the case

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[49] Ibid.
[50] Ibid.
[51] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. To Barnes from E.M Milhau, Fort Delaware Nov. 20, 1866.
[52] Ibid.
[53] Ibid.

immediately, enforced strict quarantines and all fruit and unripe vegetables were banned from the island. The next outbreak was traced to Salem, New Jersey, situated upon a small tributary in the Delaware, seven miles below the post where the disease first appeared. But there was no recurrence until the following October when several "malignant cases appeared within a few days of each other."[54]At about the same time the disease occurred "with much severity" at Bridgeton NJ also upon a tributary of the Delaware, but 20 miles down-stream.

Milhau worked with Drs. Worrell and Kemp of Delaware City, Drs. Merritt and Fromberger of New Castle, Drs. Sharp and Gibbons of Salem and of Dr. Elmer of Bridgeton to manage and investigate the disease. As was usual with this disease, race and class were considered to be powerful predisposing factors and the case reports often comment on the "intemperate habits" of its victims or that it was raging among the "lowest class of the community." One of the most interesting facets of Milhau's case reports was his use of chloroform for the treatment of cholera. Articles about the efficacy of chloroform as a treatment for cholera began appearing in European medical journals as early as 1848. Medical men in London discussed the use of chloroform in the treatment of cholera and they advocated administering chloroform orally.[55]It was thought to work like an antiseptic which stopped the disease process. It was also inhaled and used to relieve the cramps of the patient. Milhau used chloroform both ways, to stop the disease process and to treat the symptoms. For example, he administered chloroform in the case of a "negro woman 40 years of age" in the first stage of the disease, which "relieved the distressing symptoms" he then treated her with calomel, camphor and opium."[56]In other cases, he used it to relieve the symptoms in the later stages of the disease. For example, in the case of "G.J. a negro man who was attacked by epidemic cholera" was found in a stage of "imminent collapse" and was given chloroform in drachum doses every fifteen minutes to relieve the cramps. Milhau also administered camphor and opium, and together these remedies worked. The patient was "back to work in the coal wharf within 7

[54] Ibid.
[55] Johnasen, Brody, Paneth, Rachmen and Rip p. 166.
[56] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. To Barnes from E.M Milhau, Fort Delaware Nov. 20, 1866.

days."[57] While he found a measure of success with chloroform, there was little consensus about how to cure the disease.

When physicians anticipated the arrival of cholera they prepared for ways in which to either manage or prevent an outbreak. Joseph Brown, Fort Columbus New York wrote Woodward in June, 1866 to discuss his fears related to cholera. He especially advised against any sort of overcrowding which he suggested was "indisputably a dangerous experiment" and of which "experience has fully shown in frequent instances the most appalling consequences."[58] He advised measures to reduce conditions in which the disease might thrive:

> At the present time when cholera may be expected, every contingency should be avoided instead of being overlooked. Recruits are sent to this depot from various recruiting stations in many of the largest cities in this country and the chances are certainly multiplied that if there be any portability in the infection of cholera it may be introduced here. To introduce it to an overcrowded garrison on a limited area would unquestionably be a serious matter.[59]

The resources of the army allowed physicians to develop an epidemiological picture of disease while also allowing modes of transmissions to be developed. On July 26, 1866 Surgeon Joseph R. Brown wrote Woodward again from Fort Columbus about the serious outbreak of cholera that had begun earlier that month (for which he had been prepared). The first case of cholera was July 3, 1866. The patient was admitted to the hospital in "profound collapse" and died the following morning. Brown immediately began to trace the movements of the patient. He traced the outbreak to Minneapolis, where the patient had been with his regiment, listed only as "Co. D recruits." The following day another man from Co. D was admitted to the hospital with "cramps, rice water discharges, vomiting" and he "commenced collapse almost immediately."[60] Brown could not find a connection between the men in Minneapolis but more cases began to occur at Fort Columbus. This was complicated by the fact that Fort Columbus was a transfer point for regiments and there was a continual influx of new recruits and often conditions of overcrowding. For example, on the 14th of July there were as many as 1226 men on the

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[57] Ibid.
[58] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. From Joseph Brown to Woodward, June 1, 1866.
[59] Ibid.
[60] Ibid.

island. Because of the continuous development of new cases on the island Brown conducted a complete examination of the sanitary condition of the island:

> The sanitary condition of this island with this exception was excellent and every attention to this subject by frequent inspections and directions given by me. The water used by the men was not considered injurious as far as I could observe its effect except in the instance of the pump inside of Fort Columbus. The use of this water was immediately discontinued and the pump handle removed from the pump, by my advice and directions. Several cases now occurred among the prisoners and by my advice the guard house was almost entirely vacated the prisoners being sent to Castle Williams to sleep. Every precaution is taken to disinfect and properly dispose of the defections of cholera patients who are isolated from the convalescents and these again from the ordinary sick in the hospital. The wards are also regularly disinfected and kept clean and the bedding and bed sack continually changed and renewed.

Brown wrote to Woodward again from Fort Columbus, New York Harbor August 1, 1866 elucidating a couple of very important points in this report. He was concerned with the civilian employees who worked at the post but returned home to Brooklyn at night and wrote to demand an order to prevent what he believed "was the certain importation of the epidemic."[61]He was very pleased with the sanitary measures on the island and believed that they prevented any spread of the disease. To ensure that all "further importation be prevented" he suspended the work of the civilians.[62] Michael Worboys, in his discussion of British Medical Officers of Health in nineteenth-century Britain suggests that some of the main policies relating to preventative medicine which developed in the 1880s were a "triumvirate of notification, isolation and disinfection, which were supplemented in the 1890s by laboratory diagnosis, preventative vaccines and curative products."[63]These years saw the focus shift from the environment to people as the main source of infection,[64] thus the medical profession and public health agencies had newer multidimensional responsibilities.[65]American physicians were wrestling with these same issues twenty years earlier. Joseph Barnes sent letters to infected regiments asking if the disease "originated among recruits" or was "transported from other infected

[61] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. Joseph Brown to Woodward August 1, 1866,
[62] The social and political strife between civilians and the military will not be considered here—but will be considered in the book length version of this study. For more on the social and racial inequalities of the medical response to cholera see Rosenberg.
[63] Worboys, p. 234.
[64] Ibid.
[65] It is also interesting that the management of disease was on par with the European response.

points."[66]The way in which the disease was managed by some of the military physicians, particularly Brown who isolated patients, enforced strict sanitary measures, disinfection and even targeted people as the main source of infection both foreshadowed more modern practices that would emerge and develop in the bacteriological era and also gave shape to their experiences. More interestingly, the measures that he and many of his colleagues used reflected the way that gangrene and erysipelas was managed during the war. For example, isolation, disinfection and even the development (or dialogue) about remedies and laboratory tools were developed to manage infectious disease during the war, and physicians had found success once again with the same methods of investigation and prevention. The commonality in these investigations was that at least some kind of human to human transmission was increasingly being targeted as a source of contagion.[67]

J.H. Brantz, assistant surgeon U.S. Army, reported to Woodward February 21, 1867 that the first case of cholera he saw was August 12, 1866 in Camp Grant Virginia. Woodward wrote to Brantz in early 1867 asking him to pay careful attention to whether the disease "originated on the field" or "was imported."[68] This was a main concern for Woodward, since he needed to advise as to order quarantines.[69]Brantz reported that the man in question had spent the night in Richmond "in debauchery," returned to his regiment, where four more men, who also visited Richmond, were attacked with the disease.[70] Two days later, ten more cases were diagnosed. The cases were all quarantined, then Brantz inspected the cooking utensils and sanitary police and found everything to be in good order. He reasoned that the men were "exposed to the poison" while in Richmond but with the goal of "ascertaining the correctness of this supposition" he made inquiries of the board of health and "learned that the disease did not assume an epidemic form until sometime after the first cases occurred in camp." He noted that during July and August detachments of recruits were received from New York Harbor and Newport barracks and

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[66] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. The reports that were submitted to Barnes refer to his directive, which was issued to trace epidemics in 1866 and 1867.

[67] Although some physicians still had trouble letting go of the idea that individual susceptibility may have been brought on by certain environmental conditions. As mentioned earlier, no shift in this period is abrupt by any means.

[68] Woodward's Letterbook,1866-67. Otis Historical Archives RG 28 (NMHM). Letter from Woodward to J.H. Brantz Jan. 14, 1867.

[69] Ibid.

[70] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. "Report Concerning epidemic Cholera which prevailed among 11th U.S. Infantry during August and Sept. 1866" of J.H Brantz, Feb 21, 1867.

that the Sanitary Superintendent of the Metropolitan Board of Health informed him that cholera prevailed in the former at that time. He determined that cholera must have originated in Richmond or was imported from New York or Newport barracks. The exercise of tracing the origins of the disease was a valuable one even though it did not always produce conclusive results. For that to happen the source of the disease would have to be isolated, but it was possible to compile much information about its movement and ideas about the modes of transmission. Brantz's objective being to ensure the camp was hygienically sound, he adopted a number of measures, including situating the camp where it was "well ventilated," not "overcrowded, elevated with the grounds well drained" along with the employment of sanitary police.[71]These measures prevented the disease and he thus concluded that it was imported. Of 255 cases only 103 were fatal and the rest subsided. He did not specify exactly what the disease was other than referring to it as a poison—but he gives an interesting theory for how it traveled:

> Morbific matter has been conveyed long distances in clothing and excluded with contact from air and that upon unpacking and exposing the disease it has broken out in isolated places. May not the clothing of the recruits packed in their knapsacks have constituted fomites, which being unpacked here emitted material morbi?[72]

Contagionists often suggested that cholera could be transmitted directly via fomites (which could come from infected clothes) or in this case knapsacks. Brantz was curious as to whether the warmth and secure nature of the backpack somehow nurtured or harbored the "material," suggesting the disease was some sort of "virus" and when released to the population became infective. But reflecting the uncertainty related to germs he also stated that "the first victims were those whose previous debauching and indiscretions in diet, made them peculiarly susceptible to its noxious influence."[73]He was still a contingent contagionist, which was not uncommon in this period; Pettenkofer for example observed that he too "was against a simple theory of contagion" which in his opinion was "erroneous."[74]But Brantz clearly supported emerging research which suggested the existence of a separate entity that was portable and transmissible. While predisposition continued to be an important factor for causation among some physicians,

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[71] Ibid.
[72] Ibid.
[73] Ibid.
[74] Quoted in Worboys, p. 117.

others adopted strict, almost draconian, measures to prevent contagion. For example, Surgeon George Taylor, USA Chief Medical Officer, District of Texas, Galveston advised keeping cholera patients in a "perfect state of rest and to prevent evaporation from the surface of the body by close covering."[75] His measures imply that he believed that the bodies of cholera sufferers could indeed emit an infectious virus that would then be inhaled by those who came in contact with the body. He thus advised quarantining and isolating patients from the rest of the command, keeping them warm and treating them with stimulants such as carbonate of ammonia. He believed these measures together would "prolong life" and ensure that the disease did not spread among the troops.[76]

The themes of water over air and direct contagion versus contingent contagionism were factors that were continually considered in these reports. Assistant Surgeon George McGill wrote a special report from Davis Island, New York Harbor in February, 1867. A local miasmatist,[77] McGill from the beginning felt that Hart's Island, was ripe for a disease such as cholera. It was used as a rendezvous for troops recruited, or to be mustered out and as a prison from the winter of 1863-64 to the spring of 1866. He observed that approximately five thousand men a day "received their rations and cast their excretions" upon the surface of the island and on the island's "western extremity, where barracks were constructed the soil being comparatively thick, received organic remains and yielded products of their slow decomposition." He further noted that when the "atmosphere on the surface was confined and damp these products accumulated and recombined" especially under the barracks. He saw cholera as a living "organic ferment" that became virulent in the soil, gained pathogenicity and then spread to other people. As Worboys has demonstrated in regard to Pettenkofer, this was an important version of a living germ-theory of disease.[78]

McGill noted that policing was not given sufficient attention, food was not prepared with proper care and personal cleanliness was neglected. He then outlined a

[75] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. From Geo Taylor to Woodward January 9, 1867. Some physicians in the 19th century distinguished between direct contagion (touch) and infection in which people could inhale a "virus" after it was given off or exhaled from the skin or pores of an infected person. See, Johansen, Brody, Paneth, Rachman and Rip p. 177.
[76] Ibid.
[77] He generally believed that the atmosphere, seasonal fluctuations could attack people with a physiological predisposition; however, his opinions evolve through the experience (see below).
[78] Worboys, p. 126.

number of predisposing factors that contributed to the outbreak such as "feeble vital energy" and "prostrating agencies of diet and filth" in combination with the "debilitating effluvia" at Hart's Island. He held a localist interpretation of disease transmission, but his experience with this disease proved challenging. He noted that diarrhea came first and then as the "excrement of cholera fell into the soil it must have generated the so-called specific agency of cholera."[79]Like Pettenkofer, he believed the disease would not become virulent until it was incubated in soil and ingested by a person with predisposing factors. Some people acted "reckless" and came in contact with the bodies of cholera victims yet escaped, while others were not so fortunate:

> Certain persons exposed themselves recklessly and escaped. Friends cast themselves upon the bodies of the dead and remained lying upon them for many minutes having previously experienced the bad circumstances of atmosphere and diet of those who died. Does this not suggest vital energy…moreover, men assisting in post mortems and recklessly courting contact with sections of tissue escaped, while others of temperate habits fell speedily.[80]

In trying to determine the mode of transmission McGill pondered a number of anomalies. For example, was it a "comminuted force" and not a "material agency"? What explains "when the operator in a post mortem having cut himself early in his work carries the same to its end exposing naked tissue to tissue organically living and acting morbidly, yet escapes?" He examined these two theories more closely. Was it a specific disease attributable to a specific exciting cause? If it was a material, then why did people who received it in excess "whether it arose from the soil or was engendered in the air" often escape? He then considered whether it was some type of force. He did find that those with "enfeebled vital energy" were most at risk. He studied in detail symptoms, living patients and bodies to reach his conclusion:

> My observation has left me with a theory that cholera is a member of the family of diseases in which we have a morbid action of life inducible in men rendered fit by predisposing circumstances and by quality of vitality, perhaps inducible in like manner in all organic cells so its extension, infection etc. at distances varied by the degree of predisposition and transportable in organisms not in material.[81]

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[79] Ibid.
[80] Ibid.
[81] Ibid.

He concluded that forces could react with the cholera material (once part of the animal body) to produce the disease in certain susceptible people. His theory suggested that these minute products possessed properties which could be stimulated within certain environments (such as in the body with organic material.) Whether they were living organisms or chemical compounds remained elusive (to be discussed below.) But McGill recommended sanitary reform above all to manage the disease. He made no mention of quarantine measures but advised eliminating filth from the barracks and island in which the troops were stationed. His views helped garner support for sanitary reform and other developments later in the century.

There was also real fear about this disease which gave urgency to the situation and further stimulated sanitary reform. William Sloan, Medical Director from the East, arrived at Hart Island on July 31, 1866 and described the situation as follows:

> Dr. Calhoun was dead, Dr. Reese was convalescing but in bed and Dr. Webster worn out. In the hospital were 8 patients sick with cholera well marked and of a malignant type, six deaths having occurred within the previous 36 hours. The personnel broken down, and demoralized the steward sick and the ward-master dead. My first care was to police the wards and to regulate the hospital.[82]

It was particularly hard to face the loss of Dr. Calhoun who "died of cholera within ten hours":

> This ended the career of a kind hearted energetic and conscientious and intelligent medical officer whose services in the field and at the post had endeared him to all with whom he had served. He was stricken down while in the zealous discharge of his duties and his memory will be cherished by his old associates and by his former patients.[83]

Sloan examined the condition of the camp and found "diarrhea very prevalent and the morale of the men much affected." He was intrigued by the "malignancy of the disease" which suggested that "some epidemic form of the disease must exist." Part of his reasoning was that a "rigid police had been enforced, fumigations and disinfectants most literally used everywhere and still the disease was on the increase."[84]His first objective was to stop any further spread of the disease and he thus recommended moving all healthy recruits off the island, burning the straw from bed-sacks along blankets and

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[82] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. Report from William Sloan, Medical Director of the East, July 31, 1866.
[83] Ibid.
[84] Ibid.

clothing and disinfecting any baggage or bedding with "active chemical agents." He ordered fumigations of the barracks with sulphuric acid, nitric acid and chlorine. But despite these measures, the disease raged, attacking in particular the teamsters "which up until this time employed immunity" to the disease. Though he still attributed the appearance of cholera to local causes he raised some important points which would support the development of preventative medicine in the bacteriological era.[85]Firstly, he emphasized the importance of isolating the sick and preventing any further spread so that the cycle of transmission would be stopped. He also suggested that the immunity he thought certain attendants had as a result of their strong constitutions, did not exist. He also observed that the number of cases continued to increase, suggesting that it was an "unfamiliar force" or epidemic.[86]Moreover he spoke of cholera as a *specific* disease with characteristic symptoms:

> The disease was undoubtedly Asiatic cholera presenting all the symptoms of a malignant form: diarrhea, vomiting, and purging of rice water, cramps, collapsed surface, shrunken features, anxious expression, sunken eyes dark and hollow, inelasticity of the skin, incessant thirst, sensation of heat of body and extremities, entire suppression of urine, nervous agitation and sometime slight delirium, finally coma from uremia, loss of pulse and death. After death in many cases the elevation of the temperature of the body and the muscular movements were very striking.[87]

Joseph Woodward examined the number of reports and came to two important conclusions regarding quarantines and therapeutics. Although it was politically contentious, he could not discount the overwhelming evidence in favor of quarantine which were "too numerous and too important to be overlooked."[88]Physicians of the period debated theories of transmission, specifically importation versus local development but the evidence (derived from the military's ability to trace troop movement) suggested that there was some kind of human to human contact. But just how

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[85] He did not make this link—but his measures would support emerging research about microorganisms and preventative medicine in the later 19th century.

[86] Anticontagionists usually saw most cases of disease at the beginning of a stay at a new locale (e.g.with the most cases of disease up front and then waning.) It was just the opposite for contagionists who saw cases increase over time and as a result of more human to human contact.

[87] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. Report from William Sloan, Medical Director of the East, July 31, 1866.

[88] Joseph Woodward, Circular No. 5, "Report on Epidemic Cholera in the Army of the United States during the year 1866" (Washington Government Printing Office, 1867) p. xv.

complex was the discussion is well illustrated by the physician William Carroll's official report:

As to the portability of cholera there can be left no doubt; it was brought to the island and all of the residents were attacked by it. ....From the fact of some of the nurses having been attacked by diarrhea soon after nursing severe cases, I incline to the belief that a zymotic poison is produced from the patient or his evacuations, which under certain conditions of atmosphere and health, not now understood propagates the disease.[89]

Carroll also suggested that while "fear"[90]may have predisposed the patient to the attack, neither "courage," "previous good health" nor "medical aid" offered the "slightest effectual resistance."[91]

Woodward considered the many reports, which overwhelmingly supported some kind of human to human transmission. In tracing the origins of the disease, he determined that there were two chief centres and through the number of case reports compiled an epidemiological picture:

Originating in the overcrowded barracks of Governor's Island, New York Harbor, in the immediate vicinity of an infected city, through which recruits passed with more or less delay before arrival, the infection spread by readily traceable steps to Hart's Island and other posts in the harbor to Tybee Island Georgia; to Louisiana, by way of New Orleans; to Texas by way of Galveston; to Louisville, Kentucky; to Richmond Virginia and to La Virgin, Nicaragua bay. From Richmond it was carried to Norfolk, Virginia; from Louisville to Bowling Green Kentucky. The probabilities appear that the disease was carried from New Orleans up the Mississippi River to various points on that stream and west of it, and though the whole chain of evidence is not complete, there are a sufficient number of known cases of the transfer of the epidemic from one post to another in this region to put this view of the whole movement beyond a reasonable doubt.[92]

He also observed that once the epidemic appeared it often moved quickly through the rest of the camp, but success with certain hygienic measures prevented it spreading to the general population. For example, Woodward complemented the measures taken by the

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[89] Woodward, Circular No. 5, "Report on Epidemic Cholera in the Army of the United States during the year 1866" (Washington Government Printing Office, 1867) Extract from Official Reports, p. 34. Report submitted by WM. Carroll, Brevet Major and Assistant Surgeon, USV.
[90] The historian Mark Harrison examines the subjective experiences of those who witnessed and suffered from cholera. In particular, the vulnerability of British soldiers to the Indian climate along with their intemperance, poor discipline and above all, the fear that the disease invoked. Paper entitled, "Don't Panic" Cholera, Fear and Discipline in the Armies of British India, 1817-1859." Securing the Ultimate Victory Conference, Army Medical Services Museum, Ashvale Aldershot April 15-17, 2009.
[91] Woodward, Circular No. 5, "Report on Epidemic Cholera in the Army of the United States during the year 1866" (Washington Government Printing Office, 1867) Extract from Official Reports, p. 34. Report submitted by WM. Carroll, Brevet Major and Assistant Surgeon, USV.
[92] Woodward,. xvi.

physician E. McClellan, Fort Delaware, who had established a very "strict quarantine" and all "fruit and unripe vegetables were excluded from the island." He also kept a "close watch on the men's sink and anyone found with two or more discharges from his bowels was immediately placed under treatment."[93]McClellan recommended that all posts be placed in the "highest sanitary conditions" and that "rigid quarantines be enforced."[94]The idea that a predisposition and poor sanitary conditions would "spark" the disease still prevailed some in medical circles, but this theory was seen as outdated by others and more reports suggest some kind of contagion as being responsible for the disease. The physician S. Horner, Post Hospital, Louisville Kentucky, observed after extensive experience with the disease that the greatest number of cases came from one company and suggested that the disease was somehow connected to the preparation of their food. He also noticed that when the company was ordered to Bowling Green "it took the disease with it" as six more cases had been reported since their arrival there. He tried in vain to "trace the cause to indiscretions of the men" but the "rapid multiplication of cases compelled me to abandon this idea and to recognize the fact that it existed in its true epidemic form."[95]Ordering quarantines was significant since it affirmed the idea that cholera was a contagious disease and thus not local.

In 1883 Robert Koch was dispatched to Egypt to collect "epidemiological evidence on the question of importation versus local development so that he could advise the German government on quarantines."[96]The debates in Europe and the ways in which the disease was managed mirrored the American setting in 1866-7. Although by 1883 researchers were trying to incorporate germ science and laboratory techniques into their work, (and in the French and German case their work centered in the laboratory while this was very new in 1866 America and of course they were not searching for causative bacteria.) But many of the techniques adopted in the two periods were identical: inspecting potential disease carriers, isolation and quarantine, disinfection and sanitation and government sponsored investigations into the etiology of the disease. Until the late 1850s American medicine generally lagged behind Europe but by 1866 some US

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[93] Woodward, pp. 60-61.
[94] Ibid.
[95] Ibid.
[96] Worboys, p. 248. He was also searching for causative bacteria.

physicians were on the cutting edge of disease management. The experience of the war was obviously important in the development of scientific medicine in America.

Although there was consensus about how to manage cholera, the measures used were important in contributing to a larger shift in public health from what Michael Worboys has described as a move from "inclusive" concerns (primary concern with the environment) to an "exclusive" concern (focus on disease agents, people and their interactions.)[97]Civil War physicians in the postwar period were still mostly focused on "inclusive" measures but there was considerable overlap and increasing focus on "exclusive" approaches. Understanding the intricacies of this shift in American medicine becomes easier through an examination of the response to cholera in 1866. The move from "inclusive" to "exclusive" approaches in disease management (which had considerable overlap in the American case) is important in understanding medicine's larger development. In 1866, the physician's gaze generally centered on the environment, but this was becoming unacceptable as troops moved around the United States and seemed to transmit the disease to previously healthy locales. People were increasingly targeted as the potential source of contagion and as a result, the way in which the disease was managed shifted first, and specific understanding of why these measures worked developed as bacteriological models became known and understood. The shift from preventative medicine to sanitary science, in which bacteriological science and the laboratory were linked with specific modes of management, would take decades to become diffused, accepted and practiced in America. But the knowledge produced in the investigations into cholera were used to manage and prevent the disease at its most vulnerable points (suspected points of passage, for example), which suggested a more sophisticated approach to disease management. Indeed, the second area of Woodward's interest concerned "therapeutic agencies" in which little uniformity was reached during the outbreaks. Thus Woodward advised above all focusing on prevention especially cleanliness, the use of disinfectants, ventilation, proper air space and especially pure drinking water to arrest the spread of disease.[98]For example, the troops in New Orleans were supplied where practicable with rain water collected in cisterns or distilled water, to

[97] Worboys, p. 234. See also Pelling, chapter 6.
[98] Woodward, p. xvii.

great effect since the disease did not "spread to any extent among the troops thus supplied."[99]There was a record of experience and pathological evidence that was developed regarding cholera. Newer ideas about the management of cholera were beginning to gain currency, (although localist ideas about causation still existed). This did not mean there was no support for investigative medicine. In fact, the uncertainty regarding the disease proved a powerful stimulus for investigative medicine.[100]

How was cholera investigated? There was little consensus about a specific pathology of cholera because many autopsies produced different results. Physicians agreed on the common symptoms and diagnosis but a specific pathology, which could be confirmed by a number of cases and lead to uniform treatment, proved elusive. Therefore it was the further development of experimental knowledge that was important in these investigations. There were a few ways physicians studied cholera. The most common was through the patient, who was examined with a view to understanding cholera in its various stages (premonitory, inflammatory or collapse). Secondly, physicians conducted post mortems in the attempt to understand the specific manifestation of the disease. Some physicians focused on the microscopic appearances and chemical make-up of diarrhea, urine and vomit, looking for clues in the excrement of their cholera patients. Others focused on the applications of various remedies with the hope of finding a way to arrest the disease. Finally some physicians conducted chemical and microscopial experiments on water supplies. The reports were compared to determine if the disease was imported or local and how it was transmitted. Collectively, the physicians painted a comprehensive picture of the disease, and the information was transmitted in the form of circulars to state boards of health, individual physicians and the military medical department.

One of the most interesting features in these investigations was the incorporation of clinical facts in developing theories about the disease. George McGill's case histories, for example, reveal the overlapping theories of the period and the uncertainty of the pathology of the disease but also the increasing importance of laboratory style

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[99] Ibid.

[100] Woodward was also asked to prepare a report on the pathological histology of yellow fever, and he detailed his results with photomicrographs prepared at the museum. See, Joseph Woodward, ""The size of the Blood Corpuslce." Medical Record, New York (1880): 131; Woodward, "Remarks on the Pathological Histology of Yellow Fever, Prepared at the Request of the National Board of Health: Supplment No. 4" (National Bulletin of Health Washington, 1880.)

experiments in investigations. For example, in the case of Private Richard Withington, 6th Independent Company, 1st Battalion, described as a "native of Massachusetts of intemperate habits" McGill undertook a detailed investigation. The patient suffered very much with symptoms such as "aggravated diarrhea," "nausea," and "cramps in the legs and feet" and a "watery discharge."[101] Hours after admission, he began "vomiting profusely" and started to decline. McGill tried to arrest the disease by administering camphor emulsion every two hours, and attendants tried to massage the patient's cramps, which had spread from the feet to the calves, but he could "barely stand to be touched." The patient was quarantined in the quartermaster's store room, in a tent "with a very nice bed." McGill ordered the ground covered with rubber cloths and the patient was sponged with turpentine to ensure no exhalations would be released from the body, which McGill reported as "very clean." With his case report he submitted a diagram showing the patient's sunken features. McGill's desire to understand the disease is revealed through the very detailed observations he made with both with the living and dead body:

> Dr. Gibson advises five drops of the fluid extract of ergot every fifteen minutes also continuation of the emulsion of camphor. Patient did not keep it on his stomach. Vomited rice water with a little reddish color 7 ½ pm. Cramps on right side of the neck, one small passage colorless. Nose and cheeks cold. Mouth open, respiration rapid and short 8 ½ o'clock. Respiration 20, pulse 140 voice changed, collapse beginning. The ergot was given according to directions. Hard breathing contraction of the muscles of the right leg. About 9pm pupils contracted. Diverging, strabismus, tongue moist and slightly coated. Pulse 140, respirations 24, breath warm at a quarter past nine passage of a very fetid odor, brown color. Patient cold and failing rapidly. State of coma. Ergot continued. At 10 pm pulse 150, respirations 30 warm breath, extremities not cold except nose and lips apparent reaction the patient arousing from a state of profound coma. Brown color of a passage. Three quarts of fluid passed since 7'oclock. Very thirsty-water given very often in small quantities. Hypodermic injection of the fluid extract of ergot. Pulse falling 130 respiration 25. Stimulants prescribed now in addition. Tablespoonfuls of whiskey. Patient is quite hot, very thirsty asking for water all the time. 11:30 cramps again in legs and a passage of brown color.[102]

McGill then took a sample of the rice water discharge and examined it microscopically. He found what he called "bodies" or "oil globules" and shreds of

[101] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. Special Report of David's Island, New York Harbor Feb. 25th, 1867 submitted by George McGill, Assistant Surgeon, USA

[102] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. Special Report of David's Island, New York Harbor Feb. 25th, 1867 submitted by George McGill, Assistant Surgeon, USA

epithelial cells which he compared to the "numerous very minute cubical crystals so called because they strikingly resembled the blood crystals described by Virchow." He examined "bodies resembling starch granules of a bluish color" which were seen in the dried excrement. He next examined the "brownish red starch like bodies" observed in the vomit and the albumen, which was "detected in the clear supernatant fluid of the rice water evacuation."[103]He performed Pettenkofer's test for bile (which was used to determine the level of bile acids in the blood and to see what role these substances played in the disease).[104]He observed that a "red color developed after the formation of a white precipitate on the addition of sulphuric acid" which he found to be a "characteristic reaction with the vomit, with colors pronounced, though not deep."[105] The patient continued to sink and died the following day. The post mortem was made within an hour of death. McGill examined in detail the colon and the fluid of rice water discharge and epithelium. He examined the small intestines, which he noted were "hyperanemic generally," the "bladder was contracted and empty" and the patient was "severely dehydrated." He examined the ileum (in significant detail) including the "curdy substances, sanious fluid and gases," the intestinal walls, mucous membranes, solitary glands and the veins. He performed a microscopic examination of the "blood crystals in the epithelium, which were observed in the contents of the diseased segments" along with the "altered blood corpuscles, oil, globules and shreds of foreign tissues." He found that "minute crystals of blood have formed in some of the cells" which he concluded only after "repeated observations." He spent quite a lot of time examining the blood, both the red and the white corpuscles, which he found to be "more numerous than usual" and very viscid. He also examined in detail the "many fields of the red blood corpuscles" which he found "were so densely crowded together as to constitute a plenum."[106]

After commenting on the number of fat globules in the specimen of the blood, he preserved the body (through an injection of sulphate of iron, blue vitriol dissolved in water) so that he could return to the dissection when he had more time. He resumed his

[103] Ibid.
[104] He mixed sucrose and sulphuric acid with the bile to see if it would turn violet, which would indicate the presence of bile acids.
[105] Ibid.
[106] Liebig and Thiersch often focused extensively on the blood since its altered appearance was associated with poor health or abnormal function. See Pelling, p. 244. But many theories (Farr, Liebig etc. saw disease as resting in the blood—or that a chemical could excite a reaction in the blood) thus this detail to the blood was not uncommon.

examination fourteen hours later, beginning with the lungs and pulmonary veins and then he studied the nerves, glands, heart and once again the blood in detail. He injected the pericardium with a solution of sulphate of iron-pale, and was fascinated by the extent of damage. For example, he noted that the "left ventricle which was readily torn contained black blood by which the valves were stained, auricular septum perforate abounded." He again conducted Pettenkofer's test on the bile obtained from the gall bladder (which he did because the bile was so "fluid and dark.") He continued his examination with the liver, spleen, pancreas, kidneys and the brain. While most of his observations did not suggest anything abnormal, he found the intestines quite remarkable. He spent what appears to be quite a while studying the congestion, the mucous surface which he observed still had the epithelium (some physicians believed that during and attack of cholera there was a shedding of the epithelium cells). He then passed his "fingers over every line of mucous surface from the stomach to the rectum" trying to gauge the effect of the discharge from the bowels, and he conducted a microscopic examination of the "white substance obtained from the renal pyramids" the "reddish bodies" "ovoids," blood, "oil globules," "epithelium cells" and the "body fluid separating them."[107]The thoroughness of his exam continued as he proceeded to examine microscopically the fluid and substance surrounding the spleen, liver and heart. Finally, he "cast portions of the intestines into pure glycerin" so that he could make further examinations of the sections."[108]He wondered if the specific activity of the disease could be detected in the intestinal liquid of cholera patients, or if somehow the disease was reproducing in the intestinal canal.[109]Part of this was because the disease was being increasingly associated with the excrement of cholera patients, which was known to be transmitted through water (which was becoming increasingly accepted as experience with the disease developed.)

The physician T.A. McParlin and assistant surgeon Hartshuff contributed what Woodward referred to as "important practical experiments" related to the purification of their command's drinking water. McParlin and Hartshuff examined troops who had

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[107] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. Special Report of David's Island, New York Harbor Feb. 25th, 1867 submitted by George McGill, Assistant Surgeon, USA

[108] Interestingly, he notes here that his steward accidently threw the preparations out, which is unlikely. The depth and interest displayed in the report suggests that he was very interested in this body and this exam and did not want to part with the specimens by sending them to the museum.

[109] He did not, however, link the entities that he saw under the microscope as the cause of the disease.

contracted cholera while stationed in New Orleans and other ports in Louisiana during 1866. They described the various aspects of the disease but were most concerned with tracing its mode of transmission. The camp was situated in an "unfavorable locality" and the preparation of the food and the water supply was deemed "inferior."[110] McParlin ordered that "pure water be procured and issued to the troops at once" and he distributed either rain water or distilled water. He made the important discovery[111] that as a result of these measures, the troops had "enjoyed great immunity from the disease."[112] Importantly, he discovered that when rain water was scant, some men used river water and "soon cases of cholera developed." He immediately supplied pure water and there were "no more cases in that regiment."[113] He suspected the disease was propagated through the water, but rather than conducting controlled experiments on the water supplies he found it out largely by accident, as was not uncommon in the period. The "popular experiment" as John Simon noted in 1881 was "the experiment that accident does for us."[114] The ninth regiment, United States colored cavalry, and the thirty-ninth United States Infantry, proved McParlin and Hartshuff's suspicion that water was involved in the transmission of cholera:

> They were supplied, but not sufficiently, with distilled water until the cisterns at the Sedgwick were repaired, filled and furnished rain water to them. The men preferred to drink the river water because it was cold and did so against repeated warning, accepting the risks of disease rather than wait for the water to be cooled and aerated. Case after case of choleric diarrhea followed.[115]

Rather than forbidding the men to go near the river (which actually was common practice in the military) they were merely "warned" to avoid the water; but as a result knowledge was developed and strict measures were instituted.

Hartshuff later reported that "critical inspection failed to develop any other probable cause except the use of river water" and recommended to "remove the regiments away from the river far enough to prevent the men obtaining it." He found once again that

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[110] reprinted in Woodward, Circular No. 5, p. 37.
[111] Or at least saw for himself the validity of Snow's water carriage theory.
[112] Reprinted in Woodward, p. 37.
[113] Ibid.
[114] Pelling, p. 236. Simon noted in 1881 of a popular experiment in London: "performed on half a million human beings in South London, by the commercial water companies."
[115] Woodward, Circular No. 5, p. 37.

after adopting these strict measures "cholera has since ceased in the regiment."[116]Based on his experiments, "circumstances have confirmed so strongly the importance of pure water that even troops in transit or remaining a few days, its supply is recommended." It is significant that as early as 1866 physicians were targeting water supplies and treating cholera as an imported disease. The increasing emphasis on the movement of the troops and attempts to control disease though inspection stations as they travelled, suggests the development of very modern thinking about disease transmission. In other words, for some the thinking on the matter had evolved from merely associating disease outbreaks with specific locales and filth to an association with people:

> So far as I am informed, it appeared at Galveston July 22, Fort St. Philip Louisiana (in troops from New Orleans returned to their station), August 10; Whites Ranch, on the Rio Grande Texas, August 10, among troops. Dr. Merrill, one hundred and sixteenth United States colored troops, reports that several cases appeared among Mexicans at the station, a mile from camp, many days, perhaps a fortnight, and that the disease was brought by citizens from New Orleans....The recruits who arrived at the Jackson barracks in July were carefully inspected in arrival and placed in camp.[117]

Woodward agreed on the importance of the "character of the drinking water used during epidemics of cholera," which had been directly related in Europe and London to certain "organic impurities of the water furnished."[118]He ordered a chemical examination of the drinking water of the troops and he sent samples to the laboratory where B.F. Craig, Assistant Surgeon USA, was ordered to complete a report on the water obtained from areas in which the epidemic prevailed. In contrast to Hartshuff, who produced information on the dangers of water supply as part of a "popular experiment," the experiments assigned to Craig were examples of scientific experiments being developed to manage cholera. This is an important link to draw out more fully. The specific activities of the troops were monitored allowing Hartshuff and McParlin to make observations about water and the development of cholera. This information was then reported to Woodward and Barnes who ordered a controlled laboratory experiment of the water to confirm and interpret the findings. The value of experimental knowledge both as

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[116] Ibid.
[117] Ibid.
[118] Woodward, Circular No. 5, p. 37. Between 1854 into the 1880s there were a number of experiments (and debates) about water supplies during cholera outbreaks between but not limited to Simon, Snow, Thiersch, Sanderson, Parkes and Pettenkofer to name a few. The various objectives were multifactorial but most were focused on communicability, the dangerousness of water supply during visits of cholera and how to purify water safely. See Pelling, pp. 233-235.

an "attitude" or "technology"[119] reinforced the scientific usefulness of experimental knowledge, particularly because there was an immediate effect on medical *practice*.

Craig found enough organic impurities in the water to recommend the purification of water supplies. He argued that while rain water was acceptable, the best source was distilled water. His experiments focused on finding an agent capable of destroying organic matters, without harming the water. Craig was also ordered to investigate the pathology and treatment of the disease. He proceeded to analyze various disinfectants and their possible use for the management of cholera. His report was very comprehensive and well illustrates the military's response and approach to the management of cholera. His experiments centered on the interaction between various chemicals for "destroying or rendering inert certain products of decomposition in organic matter or from morbid action in the living being through the agency of a reaction in which the disinfectant itself undergoes chemical destruction."[120]Craig examined five samples of drinking water at posts in New York harbor, where cholera had occurred and made a study and comparison of the water samples with a "view to the determination of their organic matter."[121]He made two interesting points about the role of water in causing the disease. First, he suggested that it was either the "vehicle of the disease" or second, that it produced the "effects which are commonly attributed to its bad quality."In other words, was a cholera germ transmitted through the water or did something in the water react with vulnerable bodies? His method was to "digest the water for a limited period with an acid solution of permanganate of potash, and subsequently determine the amount of un-decomposed permanganate." As the digestion was stopped it "gave not the whole amount of organic matter present, but that portion of it which is in the act of decomposing, or which is the most ready to undergo decomposition."[122]He gave some important practical advice to physicians on exactly how to purify water:

A good practical rule for purifying water is to add any solution of the permanganate until the water, as seen in an ordinary sized tumbler, appears perceptibly pink. This corresponds to the addition of from half a grain to one grain per gallon. After

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[119] For more on the development of experimental practices see, Harry Marks, pp. 30-31.
[120] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. 'Report on the Disinfectants and their use in connection with cholera from the laboratory of the Surgeon General's Office" May 1, 1867 submitted by B.F. Craig.
[121] Ibid.
[122] Ibid.

standing for a few hours the color disappears, and the water is left pure as far as regards organic matter. If after two hours standing, the water has a pinkish color when received in a large white dish or in a bucket of polished tin, the amount of permanganate used has been sufficient, and if a pink color still remains after twenty-four hours, it has been used in excess.[123]

Craig also conducted various examinations on the use of disinfectants during cholera epidemics. In 1865, John Simon, British Medical Officer of Health, told members of the Privy Council that further progress in understanding cholera required "improved methods of aetiological observation and scientific researches must first have created a far more intimate knowledge than is yet current as to the nature of the morbid processes which are to be prevented, and as to the physical and chemical conditions of their development."[124]While Simon had likely wanted to conduct pathological experiments for years, this was a relatively new tool for American physicians but was a method of inquiry that became more common as a result of Circular No.2. Craig's researches, however, displayed some of the most current thinking on the topic (though he did not conduct experiments on the communicability of cholera). But his detailed chemical experiments were few and far between before the 1880s. American physicians on the other hand did have a dialogue about communicability but their ideas came from observing the troops while creating epidemiological pictures of the disease.

From the outset Craig recognized that disinfectants were successful because they acted in two possible ways: they altered a chemical process or killed an actual living body or some kind of specific poison. Craig suggested that "the methods in which chemicals act are not yet understood in all their detail" and his uncertainty was reflective of the period, particularly the difficulties that physicians had in trying to determine the etiology of cholera. The development of localized pathology during the war allowed physicians to actually see the disease in the body, and some physicians believed that the lesions caused by disease produced some kind of effect on the entire body by chemical means.[125] The German chemist Justus Von Liebig explained the disease in chemical terms in the 1840s, discussing the disease process in terms of fermentation, putrefaction and decay, where "disease was seen as spreading internal rot, that came from external rot, and could be

[123] Ibid. also reprinted for the benefits of all physicians in Woodward's report. See Circular No. 5, p. xviii.
[124] Quoted in Pelling, p. 237.
[125] For more on chemical theories of disease and therapeutics see Worboys, pp. 33-35.

transferred to others."[126]He looked at the chemical changes or breakdown in organic molecules caused by ferments. As Worboys has suggested of Liebig's theories, ferments were not thought to be disease entities but rather "catalysts that could, in the right bodily and environmental conditions, initiate disease processes."[127] Like Liebig, Craig's theories were rooted in ideas of decomposition and degeneration: the idea that some kind of chemical miasma reacted with the body and as organic material decomposed, putrefaction would result (in contrast to Pasteur who later demonstrated that fermentation *required* the action of living microganism).[128] Craig primarily focused on the "class of antiseptics or of bodies which antagonize putrefaction" but there was some overlap in his ideas.[129] He also examined how to "prevent or delay spontaneous decomposition," which seemed to belong in a greater or less degree to all substances which were "capable of combining with or impregnating organic matter and which are at the same time themselves of stable composition and not possessed of any very powerful chemical affinities."[130] From his experiments, Craig advised Woodward and Barnes how to manage certain environmental and public health areas that were deemed a threat. Both his findings and his experiments were very sophisticated and incorporated the most up to date information on disease. He examined a number of agents including chloride of sodium and many of the more "stable forms of organic matter" such as sugar or alcohol, which he suggested should be considered part of the "class of antiseptics and all such bodies when come in contact with substances prone to putrefaction" and which may be imagined to act in the manner of cements, holding together by their own molecular adhesiveness, the loosely connected atoms of organic matter."[131]He continued:

It has been moreover very clearly observed that the most efficient of the volatile antiseptic possess probably in virtue of their power of imparting stability to matter, a poisonous influence over those organic germs which play so important a role in the

[126] Quoted in Worboys, p. 34.
[127] Ibid. p. 35.
[128] Physicians throughout the war wondered about the role or putrefaction: did it follow from bacteria or did it appear where there was bacteria?
[129] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. 'Report on the Disinfectants and their use in connection with cholera from the laboratory of the Surgeon General's Office" May 1, 1867 submitted by B.F. Craig
[130] Ibid.
[131] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. 'Report on the Disinfectants and their use in connection with cholera from the laboratory of the Surgeon General's Office" May 1, 1867 submitted by B.F. Craig.

propagation of putrefactive fermentation; and in fact over all the lower forms of organic life. [132]

The language here was important. In the 1850s and early 1860s it was common to refer disease processes purely as chemical but by 1865, largely as a result of Pasteur's discoveries, some scientists discussed disease as "vital processes."[133]Craig's work suggests a growing acceptance of "lower forms of life" in the disease process. For example, he examined the "bodies" or "organic germs" that were held together by their "molecular adhesiveness," and which seemed to contribute to putrefactive fermentation. Thus his experiments centered on how antiseptics could either bring about the "final decomposition of infectious and offensive matter" or that would "change and prevent decomposition." His overall objective was to determine exactly how disinfectants worked in the treatment and prevention of disease, but his work suggests that there was also a move towards the idea that living germs caused the disease.

His first study centered on ways to prevent a "virus of a disease which is diffused through the air or impregnates buildings" in other words, to kill any airborne germs.[134]He suggested that although the vapors of burning sulphur had been used for decades "their power seem to have been partially forgotten in modern times but the last two or three years have witnessed new trial and new proof of their value in the epidemics of the cattle plague in England and of cholera in this country."[135]Historians have examined the significance of animal models in pathological research that helped gain support for bacteriology after the 1870s[136]but there has been little consideration of this development in the American case. Craig's comparison of the cattle plague in England in the summer of 1865 and the cholera outbreaks in 1866-67 was an interesting one. During the cattle plague most elite physicians in England debated the efficacy of antiseptics and how they could be used to manage the plague while others advocated quarantine and policing.[137]Craig in fact advocated both:

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[132] Ibid.
[133] See Worboys, p. 34.
[134] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. 'Report on the Disinfectants and their use in connection with cholera from the laboratory of the Surgeon General's Office" May 1, 1867 submitted by B.F. Craig.
[135] Ibid.
[136] Worboys, pp. 43-44.
[137] Worboys, p. 51.

> In New York during the year of 1866 when repeated cases of cholera had occurred in a house giving evidence that it had become generally infected with the virus of the disease, the board of health adopted the expedient of closing it and of fumigating it together with its contained furniture, clothing and in some cases with the burning of sulphur and in some cases with chlorine gas each of which measure seemed to be thoroughly effective. When sulphur was used it was put in pans and supported on long legs. Apertures in the building having been closed the sulphur was set on fire first in the upper rooms and then in the lower after this the house remained closed for several hours, when it was open ventilated and reoccupied.[138]

He also advised using the vapors of alcohol, carbolic alcohol and fossil oil which "offered considerable efficacy in checking decomposition." He was once again particularly interested in the research coming from England:

> The two homologous substances carbolic and cresylic alcohols or more properly carbolic and cresylic alcohols have been used separately and conjointly as a means of arresting this spread of the cattle plague in England and as would appear with the most marked success. The power of even small quantities of these liquids in arresting putrefaction and in destroying the lower forms of animal life is very great, and they have this advantage over the fumes of burning sulphur that they are themselves more permanent than sulphourous acid which undergoes gradual oxidation when exposed to the air so that it cannot be relied on for the continuous preservation of a mass of organic matter except in closed vessels. These cool tar alcohols have not as yet been much used in this country but creosote a body closely allied to them in physical properties and antiseptic powers is well known and easily procured and carbolic alcohol, now on the supply table of the medical department, can be obtained from medical purveyors.[139]

He then related the use of these antiseptics to the propagation of cholera, which suggested that "the virus is not eliminated as such from the bodies of cholera patients, but that it is formed in their discharges by some specific process of decomposition, a process which is supposed to go on only in alkaline fluids."[140] He advised Woodward then that the sanitary measures adopted must "retard putrefaction in the discharges and to keep them if possible in an acid condition." He suggested that metallic salts or sulphate of iron

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[138] RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. 'Report on the Disinfectants and their use in connection with cholera from the laboratory of the Surgeon General's Office" May 1, 1867 submitted by B.F. Craig.

[139] Ibid. Interestingly, he suggests that in killing the "lower forms of animal life," putrefaction will be arrested suggesting a biological interpretation of putrefaction. Carbolic alcohol had been used with success during the war.

[140] Ibid. He did not however go into detail here. For, example he did not say whether they formed in the person and then were released in the discharge and transmitted to another body—rather he says formed in the discharge. During the same period, Karl Theirsch (who worked with Pettenkofer and Liebig and together they were referred to as the "Munich Chemists") undertook experiments to prove the communicability of cholera person to person, but found that "cholera evacuations are not at first capable of generating the disease"—there was the thought that there was some change in the development of the disease after leaving one person and entering another. See, Pelling, p. 247.
Craig may have held a similar viewpoint. Pettenkofer similarly said that there needed to be some kind of change or fermentation in the excretions for the disease to be propagated.

should be added either in powder or in saturated solution to vessels in which the discharges of cholera are received and to privy vaults and boxes and that the findings be adopted by the state boards of health. He specifically advised the use of sulphate of iron or some other metallic salt such as chloride of zinc as the most important of the disinfectant measures to be adopted during the prevalence of cholera, specifically "regarding cholera discharges as the medium through which the disease is propagated."[141] Craig proposed that chemicals "oxidized" or "consumed" organic matter and worked by "attacking the more advanced products of putrefaction first" and thereby altering or stopping the disease process. His experiments centered on using disinfectants to destroy or dispose of all dangerous material caused by the disease (or the disease itself). He used the analogy of putrefying meat to explain how the disinfectant acted:

> If a piece of putrefying meat be exposed to chlorine gas all offensive odors will be removed, but after the chlorine has been exhausted, putrefaction will go on as before. If on other hand it is acted on by creosote or carbolic alcohol no disinfectant will be evident at first, but the odor of putrefaction will pass away in time and the meat will then be found indisposed to further decomposition, will be in fact in the condition of smoked meat. The proper use therefore for oxidizing disinfectants is to decompose effluvia and to destroy small quantities of organic matter rather than to deal with great masses of it.[142]

He advised also using chlorine or "equivalent gases" in the air of the sick room or ward and solutions of chlorinated lime or soda for washing floors and for disinfecting bed clothes and linen. He advocated the use of permanganate of potash to disinfect clothes and sick wards, a strategy that had been successful during the Civil War. Indeed, Frank Hinkle had similarly found the agent effective in the gangrene wards at the Jarvis General Hospital in 1864; once again Craig was advocating it for the cleaning of clothes, undergarments and bed-linen which had been soiled by the discharge of the patient. One important point to emphasize is that his experiments and remedies suggest that he did not completely subscribe to the water carriage theories for cholera; aerial transmission was still not completely abandoned. But Craig advised a number of almost draconian methods to prevent and manage cholera, which were quite medically sophisticated.

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141 RG 94 (NARA) "Reports on Diseases and Individual Cases, 1841-93" Papers relating to Cholera, Smallpox and Yellow Fever Epidemics, 1859-1983" P1-17- Entry 620. 'Report on the Disinfectants and their use in connection with cholera from the laboratory of the Surgeon General's Office" May 1, 1867 submitted by B.F. Craig.

142 Ibid. William Farr, in the 1850s, advanced the theory that contagious disease was caused by "organic particles" that were inhaled, and then started a process of chemical decay inside the body. Like Liebig his theories also helped inspire public health campaigns. See, John Waller, *The Discovery of the Germ: Twenty Years that Transformed the Way we think about Disease* (New York, Columbia University Press, 2002) pp.54-57.

He recommended using a saturated solution of sulphate of iron combined with a solution of sulphuric acid, or chlorine and salt combined with a solution of iron. He suggested that either solution be "mixed with the discharges in all cases of cholera and diarrhea in the proportion of from five to fifteen percent of the amount of fluid present." His goal was to eliminate any change in fermentation that might have resulted in the excretions of cholera and in turn be transmitted through the water supply to other people. He also advocated treating all water closets with a solution of chlorinated lime and after a day, a solution of sulphate of iron or of common salt. He then recommended using a solution of carbolic acid on the floors and walls of privies, and clothes "soiled by cholera discharges" were to be soaked in a solution either of permanganate of potash, chlorinated lime or soda before being washed. All buildings were to be fumigated, whitewashed and sprinkled with a mixture of lime or a solution of carbolic acid. Finally, he reiterated that it was crucial to disinfect drinking water and provided detailed instructions on the method for purifying of water as well as suggesting that meats and food storages be treated with a solution of carbolic acid. But his recommendations were not merely based on a view that there was a mysterious filth but rather that there was specific "organic matter" even living "germs" in the water and the discharges of cholera patients that needed to be destroyed.

The results of his work and ideas for managing cholera were important. Although he did not find the specific contagion of cholera his ideas incorporated the most up to date information on the disease. First, he advocated quarantines and strict policing; secondly, the disease was treated as an importation (that men would bring it to camp and transmit through excretions). Third, in managing the disease he targeted water supplies and the excretions from the bodies of cholera patients as the source of contagion (though he still articulated a version of Pettenkofer's theory.)[143]He discussed "organic germs" and "lower forms of life" as "propagating the putrefaction" paving the way for the acceptance of bacteriological theories of disease. He also thought of the disease in chemical terms, though his language "low forms of life" suggests he also thought the disease process was a "vital" process.[144]When he advocated the use of antiseptics to exert a "poisonious

[143] His theories were still being debated in Europe in the 1880s so it was certainly not backward be in alignment with Pettenkofer. See Worboys, pp. 248-252.

[144] However, Margaret Pelling has demonstrated that these two theories "eventually emerged as being complementary." "Contagion, Germ Theory, Specificity," P. 327

influence" over antiseptic germs he was suggesting altering a chemical breakdown *or* killing an organic germ that may have been propagated by putrefactive fermentation. Perhaps most important, however, was his extensive use of chemical and microscopial analysis to produce knowledge about the disease. Moreover the knowledge he produced, particularly on purifying water (and even that it should be purified as a matter of policy) did much to support the efficacy of scientific methodology in the practice of medicine. Despite uncertainty about the disease itself, the medical department prided itself on measures developed to combat its spread and even the incidence of cholera. Craig and Woodward incorporated the knowledge generated by the State Boards of Health into the larger findings of the military medical department, creating an important network of knowledge between civil and military authorities. This connection proved invaluable for the continued development of knowledge in the post war period. Indeed, the findings of these investigations as contained in Circulars No. 1 and 5, were requested by physicians in Vienna, Berlin, England and Moscow as well as state boards of health in America.[145]

The Toner Lectures:

One of the most interesting and perhaps important aspects of Civil War medicine was the personal relationships that developed from the war. These relationships were important to the physician veterans and were frequently commented on in the post war period. Doctors who had ministered in the war were linked by the common experience and a distinctly American medical identity that was rooted in the wartime experience.[146] They often consulted each other on various projects and continued to work together to develop or institutionalize scientific medicine. The Toner Lectures was one result of this community of investigators—many of whom began the research to which their lectures pertained during, and as a result of the Civil War. The Toner Lectures were instituted by John M. Toner and were designed for that scientifically minded physicians to present "memoirs or essays relative to some branch of medical science" which demonstrated "some new truth fully established by experiment or observation."[147]The lectures were

[145] Most of the letters were positive and complementary of the military's work and management of disease. Indeed, the Moscow Surgery Society thanked them in particular for the cholera circular and "respectfully begs the Washington Surgeon General's Office to continue sending any of their medical publications and offers to forward all those that the Moscow society will publish." Incoming Correspondence, 1862-1894 OHA RG 13 Letter to Barnes, Oct. 26, 1868.
[146] We see again the importance of civil and military relationships in the development of medical science.
[147] The Toner Lectures: Instituted to Encourage the Discovery of New Truths for the Advancement of Medicine (Washington, Smithsonian Institution, 1873) Most of these lectures were reprinted in numerous national and

specifically intended to "increase and diffuse knowledge," some of which had begun with the war. Joseph Woodward was invited to inaugurate the series, speaking on the "Structure of Cancerous Tumors, and the Manner in which Adjacent Parts are Invaded."[148]He had been interested in cancer research prior to the war but his methodology developed in relation to some of the opportunities presented by the war, particularly while he was curator of the medical section of the Army Medical Museum where he used the tools and resources provided by the government to develop his expertise in histological research and photomicrography. In recognition of Woodward's expert status Dr. Toner invited Woodward to "contribute something that would aid the general practitioner in the diagnosis of cancerous from other morbid growths."[149] As Woodward observed "the present uncertain condition of the question of diagnosis greatly facilitated the operations of charlatans by enabling them to report cures of cancer in almost every instance in which a non-malignant growth is removed by their caustic pastes or plasters."[150]The lecture series provided an opportunity once again to assert the supremacy of medical science over the ideologies of competing sects and increase support for scientific methods.

Sharing and developing knowledge was important to Woodward, and he was pleased to present his work to an audience of more than one hundred physicians.[151]He spoke about the anatomy of cancerous growths and illustrated his lecture with specimens from the collection at the Army Medical Museum, which he compared to preparations obtained from European histologists.[152]He projected the preparations on a screen with an oxy-calcium lantern and showed more than seventy microphotographs of selected preparations. It was significant that he *demonstrated* the technique of microphotography, an investigative tool that was almost brand new in America. After he discussed mostly

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international medical journals. Woodward's article for example was published in the Edinburgh Medical Journal, 1874; Philadelphia Medical Times, 1873-4; Atlanta Medical and Surgical Journal, 1874-4; American Journal of the Medical Sciences, 1874.

148 Ibid.

149 Ibid.

150 Ibid. p. 3.

151 Ibid.

152 Joseph Woodward, "On the Structure of Cancerous Tumors, And the Manner in which Adjacent parts are Invaded, delivered March 28, 1873." The Toner Lectures: Instituted to Encourage the Discovery of New Truths for the Advancement of Medicine (Washington, Smithsonian Institution, 1873) He was able to do this because as demonstrated in chapter 3 he wrote extensively to leaders in the field to establish techniques, exchange information etc. See also, Woodward Photographs and Photomicrographs OHA RG 83 (NMHM)

the anatomical facts and clinical phenomena related to his cancer research he encouraged physicians to pursue their own research:

You will the more readily agree with me when I express the opinion that so far from this branch of the inquiry having been exhausted (anatomical facts) additional investigations are urgently needed and ought by all means to be encouraged.[153]

He suggested to the physicians present that further research was needed, with a view to "relating the clinical and anatomical symptoms of cancer research" and to explain the "aberrant phenomena" of cancer cells. Woodward's wartime work conferred on him a high measure of social and scientific authority and he used this intellectual influence to promote research and professional industry. It was very similar to the climate that had developed in relation to wartime challenges. Civil War physicians were encouraged to find improved ways to treat, diagnose and ideally prevent disease, as in the case of gangrene or cholera, and research and experimental method was effective for managing disease within the wartime environment. This ethic continued to develop in the post war period—first among those that doctored in the war but they were a powerful force for aligning medicine towards research and investigation.

Horatio C. Wood, who served in a number of both military and civil hospitals in Philadelphia during the war and developed an interest in the action of therapeutics on the body and nervous diseases, was also invited to give a Toner lecture, speaking on the "Nature and Mechanism of Fever." [154]He was a professor of botany in the Faculty of Medicine at the University of Pennsylvania and a clinical professor of diseases of the nervous system. He contributed numerous case histories to both the Army Medical Museum and the *Medical and Surgical History*, suggesting that some of his experimental researches, especially related to therapeutics, originated in his wartime work and developed within that culture. Importantly, in the 1870s Wood became a vocal proponent

[153] Ibid. p. 35.

[154] Horatio C. Wood, "On the Influence of Section of the Cervical Pneumo-Gastrics upon the Action of Emetics and Cathartics," *American Journal of Medical Science,40*, p. 75 ; "Acetic Ether as an Anaesthetic,",*vol XJ.* 137; "Physiological Action of Atropia," *ibid.*, vol. XIV., p. 128 ; " Experimental Researches on the Physiological Action of Nitrite of Amy!" *ibid.*, vol. IXII, p. 39; "The Vaso-Motor Ac- lion of Ergot," *Philadelphia Medical Times*, May, 1874"; On the Oxytoxic Action of Quinine," *ibid.;* "An Investigation into the Action of Veratrum Viride," *ibid.*, and reprinted in pamphlet; "Thermic Fever, or Sunstroke (Philadelphia: J. B. Lippincott & Co., 1872); "A Study of Convulsants," *Philadelphia Medical Times;* "Case of Leucinosis, or Yellow Atrophy of the Liver," *American Journal of Medical Science*, vol. l., p. 418; "On Acute Dropsy, Scarlatinal and Idio- pathic," *ibid.*, vol. IXII., p. 75 ; " Therapeutic Value of Nitrite of Amyl," *ibid.*, vol. IXII., p. 359; " On the Relations of Leucocythoemia and Pseudo-leukœmia," *ibid.,vol.* IXII., p. 373 ; "A Treatise on Therapeutics,"(Philadelphia: J. B. Lippincott & Co., 1875)

of scientific medicine claiming that "knowledge produced in the laboratory was the proper platform for uplifting medical practice."[155]William Williams Keen also lectured in the series on the "Surgical Complications and Sequels of the Continued Fever" and Jacob DaCosta presented his research entitled 'On Strain and Over-Action of the Heart" which he illustrated with specimens prepared at the museum and his Civil War case studies. Once again he discussed functional heart disease turning into organic disease of the heart but he linked the disorder with heavy labor, which was of great interest to civil physicians.

These researchers perhaps inspired the next generation of young doctors with their method and industry. For example, Edward O. Shakespeare gave a lecture on "The Nature of Reparatory Inflammation in Arteries after Ligatures, Acupressure, and Torsion" and became later part of the Reed-Vaughn-Shakespeare-Sternberg board on typhoid fever during the Spanish American War. He later worked with George Miller Sternberg, who served in various capacities during the Civil War.[156]Sternberg focused his career on preventative medicine, research and the development of scientific medicine. He became Surgeon General in 1893 and almost immediately founded the Army Medical School and "inaugurated the custom of assigning officers to stations in large cities where they might have the advantage of abundant laboratory and clinical facilities."[157] He was also known for greatly improving military hospitals especially during the Spanish American War. He worked to establish the laboratories of bacteriology and hygiene in connection with the Army Medical Museum and provided facilities for the work in every military post.[158] Koch referred to Sternberg as the "father of American bacteriology" and he was perhaps America's most renowned military physician; but he carried on the tradition of research established during the Civil War. For example, Sternberg, like B.F. Craig before him, had a passion for testing the practical value of disinfectants, but went a

[155] Quoted in John Harley Warner "Fall and Rise of Professional Mystery" p. 132.
[156]Assistant surgeon 1861 with General Sykes Command Army of the Potomac, in the hospital at Portsmouth Grove to Nov. 1862, as Assistant to the Medical Director of the Gulf to Jan. 1864, in the Office of the Medical Director, Columbus Ohio and in the United States General Hospital in Cleveland Ohio to July 1865.See the George Miller Sternberg Papers MS C 100 Box One: 1861-1917 National Library of Medicine.
[157] Ibid. Stephen Craig, Uniformed Services University of the Health Sciences, Bethesda MD, presented a paper at the "Securing the Ultimate Victory" Conference, Ashvale Aldershot, April 17, 2009 on George Miller Sternberg's considerable achievements in medical science. Craig's monograph, a biography of Sternberg, will be published later next year.
[158] Ibid.

step further using "putrefactive bacteria in the test of germicidal activity."[159]He also worked at the Army Medical Museum and in the tradition of Woodward, produced for the first time, photomicrographs of the tubercule bacillus.[160]He is best known perhaps for his bacteriological milestones, being the first physician in the United States to demonstrate the plasmodium organism as cause of malaria (1885) and to confirm the causative roles of the bacilli of tuberculosis and typhoid fever (1886). Sternberg created the Typhoid Fever Board (1898), consisting of Majors Walter Reed, Victor C. Vaughan, and Edward O. Shakespeare, which established the facts of contact infection and fly carriage of the disease.[161] In 1900 he organized the Yellow Fever Commission, headed by Reed (professor of bacteriology in the Army Medical School), which ultimately identified the mosquito in the transmission of yellow fever. But most importantly, he exemplified the type of military physician that Hammond, Woodward, Keen, Mitchell, Buck and the like envisioned. Sternberg, like his predecessors, always insisted on the importance of combined medical research and military service.[162]

Perhaps most important, these lectures suggest that a specific cast of mind developed among some of the War physicians. They continued to promote research, experimental medicine and scientific accomplishment, which helped set American medicine on a new scientific course. This was further evidenced by America's presence at the International Medical Congresses,[163]The International Exposition, numerous scientific meetings and demonstrations in America, Europe and the UK in which American physicians were now contributing to the various programs as producers of medical knowledge.[164] Indeed, many of the War physicians (and their protégés) were instrumental in contributing to the intellectual transformation of the profession in the third quarter of the nineteenth century.

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159 Medical Officers Who Have Made Contributions of Worth to the Science of Medicine. National Library of Medicine MS B 281, Armed Forces Medical Library Document Section.
160 Ibid.
161 Ibid.
162 Like Hammond, Sternberg also emphasized the importance of civil and military medical cooperation.
163 Held in Paris (1867), Florence (1869), Vienna (1873), Brussels (1876) Philadelphia (1876) Washington (1888) etc.
164 For some examples the contributions and meetings see, US Centennial International Exhibition (1876) OHA RG 12 and International Exposition of 1876: The Medical Department OHA RG 76 (NMHM).

Conclusion:
Post-War Reflections

The unprecedented opportunity that the war offered for the development of research and investigative medicine and its role in "advancing medical science" was a key objective of the Union medical department. Discussing the effect of the war on each physician that benefited from the experience is an impossible task,[165]but some examples elucidate the impact of the war to individual physicians. Some physicians gained the practical experience they desperately lacked while others realized that medicine and disease were complex and mastery demanded more than merely amassing clinical information. These factors worked together to create a dynamic professional environment and had a tremendous impact on some American physicians. W.W. Keen for example was profoundly affected by the experience of the war. In 1860, he entered the office of John Brinton, Jacob DaCosta and S.W. Mitchell, as a new medical student at Jefferson Medical College, never having so much as touched a microscope. During a regular course at Jefferson in antebellum America he may have performed a few dissections if he was lucky, become familiar with the basics of anatomy and with the work of some of the leading medical practitioners around the world. The war experience on the other hand offered the kind of medical intervention that would help him to transform American medicine and establish his own career. He collected, dissected, studied specimens, engaged in novel research projects while at Turner's Lane, pioneered experiments related to malingering and published numerous articles on his research. He became a significant producer of medical knowledge in just five years but his interests, which developed with the war, continued to take shape throughout his career. By 1865 he was picking up medical equipment for Jacob DaCosta in Germany[166]and discussing his wartime research with Claude Bernard:

> When I went to Paris as a student in the winter of 1864-65, I took a copy of *Nerves and Other Injuries* to Claude Bernard and showed him the history of this patient. It was the first confirmation in man of his experiments on animals. His enthusiasm

[165] More than 12,000 physicians served on both sides of the conflict, and they greatly impacted the next generation of physicians who benefited from the newer methodologies or the networks of knowledge in place (men such as Osler and Welch). I would like to return to this subject for a second monograph and examine the post war careers of the many physicians that served in the war. Some of the men discussed here were featured throughout this study and had a significant impact on medicine in the later 19th century.

[166] Library of College of Physicians and Surgeons, Philadelphia Keen Papers, MSS 2/0076-04. Letter from DaCosta to Keen, Feb. 8, 1865 in which he thanks Keen for the heart stethoscope and larynscope.

naturally knew no bounds. Only those familiar with medicine can appreciate how profoundly important in anatomy, physiology, pathology, medicine, surgery and therapeutics this discovery of the function of the sympathetic nerve has been. It fundamentally altered out views and our practice in all these departments. [167]

His expert status did not go unnoticed. In Keen's personal correspondence are hundreds of letters from physicians in America, Europe and Canada asking his advice on nervous injuries, "imbeciles," "brain disease," cerebral surgery; this expert status relating to experimentation, nerve injuries, brain disorders and far more stemmed from his war work, which was referred to often.[168]Not every physician that served during the war profited in the same way as Keen but it did lead to a hierarchy of knowledge and a recognition of the complexity of medicine, paving the way for further medical reforms and a new reverence for scientific medicine. Looking back on his career in 1912, Keen recalled two important turning points. The first, the "one great opportunity in my life—the turning point in my surgical career" was the successful operation for a brain tumor, one of the first in America.[169]The patient recovered and Keen went on to operate in "two more brain cases" and gain renown for his work which was one of the topics at the 1888 Medical Congress. The other turning point in his career was the Civil War, at Turner's Lane. He suggested that his "Gunshot Wounds and Other Injuries of Nerves" published in 1864, was the "foundation of the whole modern surgery of the nervous system."Keen noted of his position at Turner's Lane in 1864:

> No sooner did this class of patients begin to fill our wards, than we perceived that a new and interesting field of observation was here opened to view. Before long, so many of these cases were collected that for a time, they formed the majority of our patients. Among them were representatives of every conceivable form of nerve injury—from shot and shell, from sabre cuts, contusions, and dislocations. So complete was the field of study that it was not uncommon at one time in the wards four or five cases of gunshot injuries of any single large nerve. It thus happened that phenomena which one day

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[167] The patient had one pupil that was contracted to the size of a pin-point. He was diagnosed with having a division of the sympathetic nerve. The case history is recorded in Mitchell, Morehouse and Keen, *Gunshot Wounds and Other Injuries of Nerves*, 1864 p. 39 After his visit with Bernard Keen went on a tour of Virchow's laboratory, which he enjoyed very much. Keen, *Reminiscences*, p. 224.

[168]: W.W. Keen's Correspondence, 1860-1931. MSS 2/0076-04 Box 1-3 , Ser 1-2 Library of the College of Physicians, Philadelphia

[169] With Drs. Mitchell, Wood, Lewis, Harlan and Oliver Keen "operated and when removed the trephine button from his skull saw the tumor where he had diagnosed it—removed the tumor—passed my little finger around its margin and peeled it out as easily as one scoops a hardboiled egg out of its shell with a spoon. No hemorrhage; not a lot of blood." American Philosophical Society (B K245) "Reminiscences for his children; 1912 with additions 1915" pp. 42-47..

seemed rare and curious the next day grew commonplace as our patients became numerous.[170]

The two events were not unrelated. As demonstrated in chapter four, the development of specific methodologies relating to neurology was important, but Keen defined his medical identity through this work. The institutional support for medicine's larger development was commented on frequently but the other striking effect of the war was the immediate success for the individual physician.

John Shaw Billings, for example, a young contract surgeon in 1861 was regarded as the foremost authority in public hygiene and hospital construction by 1874.[171]The *Boston Medical and Surgical Journal* noted in February 16, 1871 of his essay on ventilation and warming of barracks and hospitals, "As in all recent investigations made at the Surgeon General's Office, the work has been carefully and thoroughly done and the volume adds a valuable contribution to the literature of medical sciences."[172]Indeed, "we have rarely met with so much good advice in so few words."[173]Billings became medical advisor to the trustees of the Johns Hopkins fund in 1876, drew the ground plans for the hospital and medical school and was instrumental in securing William Welch and William Osler to the staff at Johns Hopkins. Billings became librarian and curator of the Army Medical Museum December, 1883 and in 1889 the director of the hospital and hygiene laboratory at Johns Hopkins.[174]Perhaps most importantly, however, he had formed valuable relationships during the war that continued in the post war period. One of these was with Isaac Mini Hayes and they worked together to bring the International Medical Congress to Washington in 1888. The executive congress committee consisted of Hays, Billings, Bowditch, DaCosta, Leidy, Stille, Mitchell, and Thompson (all of whom doctored in the war) and of course younger physicians such as Osler also sat on the committee.[175]The committee resolved to "extend on behalf of the medical profession of the United States to the International Medical Congress....a cordial invitation to have the

[170] Silas Weir Mitchell, George Reed Morehouse and William Williams Keen, *Gunshot Wounds and Other Injuries of Nerves* (Philadelphia, Lippincott, 1864) p. 2.
[171] Medical Officers Who Have Made Contributions of Worth to the Science of Medicine. National Library of Medicine MS B 281, Armed Forces Medical Library Document Section.
[172] Data relevant to the Library in the Annual Reports of the Surgeon-Generals' Office MSC 185 (NLM) quoted from the *Boston Medical and Surgical Journal* Feb. 1871
[173] Ibid.
[174] Ibid. See also, *Army Medical Bulletin*, (60) January, 1942.
[175] Issac Mini Hayes Papers (APS), BH334. 1

next International Medical Congress at Washington DC in 1888."[176] Part of the lure of Washington was to tour the Army Medical Museum as part of the conference.[177] In fact, the meetings leading up to the Congress were held at the Museum and members of the AMA were encouraged to attend. In the correspondence from Billings to Hayes, it was noted that "the work of the Congress shall be of an exclusively scientific character" and the explicit goal was to "discuss matters of science and practice with the medical men of Europe as well as each other."[178] At the opening of the Congress, Billings as President gave the address:

All of you are interested in medical science, not merely as a means of giving new modes of diagnosis or treatment, but also for its own sake, the sake of knowing, for the pleasure of investigation, and in the hope of helping others…and while the majority have devoted themselves more or less to special branches, they have not, in doing so lost interest in what may be for the general good of the whole profession.[179]

In his address he articulated the importance of the most significant and enduring medical legacy of the war: the Army Medical Museum. He observed that over the past decades, the "general government has in its turn done something for medicine and for you by founding the medical library and museum in Washington under the direction of the Medical Department of the Army."[180] As Billings continued to discuss the collections in the various medical museums around the world, he made an important distinction between some of them and the AMM. Many collections focused on anatomical abnormalities or even comparative anatomy but Billings made it clear that the ideology of the AMM developed along different even distinct lines:

…in speaking of the scope of our museum, I said it included "human anatomy." This phrase does not mean that it has no specimens illustrating the structure of other animals,--for it has many and needs more; but it means that in this department the main purpose is not to make comparative anatomy an end to itself by exhibiting all known variations in structure throughout the animal kingdom as a basis for their study in relation to development, environment, causation and results. In other words, it is not an anatomical museum but a medical museum….this will be useful in explaining why certain parts of the body thus, and not otherwise.[181]

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[176] Ibid.
[177] Ibid.
[178] Resolutions from Billings to Hayes, June 28, 1883, Issac Mini Hayes Papers, BH334. 1
[179] John Shaw Billings, 'On Medical Museums: With Special Reference to the Army Medical Museum at Washington," *Medical News*, September 22, 1888. P. 4.
[180] Ibid. p.4.
[181] Ibid. p. 13.

He discussed the importance of experimental pathology, pharmacology and physiology as a basis for comparison with abnormal pathological specimens obtained from the same animals. While the focus of the collection changed after the war, the ideology was the same: to learn, teach, study and develop medical knowledge from bodies. For example, Woodward compiled organs in the various stages of disease in his diarrhea research in the attempt to trace and understand its progress. For Woodward the AMM was synonymous with scientific development in America:

> The consideration hitherto presented are, let me hope, sufficient to make it plain that it was the bound duty of the Surgeon General's Office to undertake that scientific work of which enough has already been published to enable the medical profession throughout the world to form a judgment as to its character, and as to the fitness of the medical officers to whom it has been entrusted to accomplish the task which they have undertaken. The medical criticism of the Old World has already proclaimed the verdict, which has been altogether favorable.[182]

There were of course many differing debates in the post war period about disease transmission and other medical matters, but important patterns such as the culture of professionalism or research at the Army Medical Museum, continued to develop along the same lines after the war as it did during the war. For example, the meetings during the war at the AMM or the Smithsonian to address wartime medical challenges continued though the focus shifted to relevant health crises or as a means to promote scientific industry. But the medical culture established during the war (individual industry within a larger body of work, professionalism, networks of knowledge) continued into the later nineteenth century. Through the 1870s and 1880s, Billings sent out numerous letters to both civilian and military physicians asking for specimens for the museum's collection. He was pleased to receive a 5 week old fetus, for example, from Dr. AJ Mack, a fetal skeleton and collection of hyoid bones from Dr. Matas and two cancerous testicles from Henry Ward, which were submitted for study and analysis and also to contribute to the cabinet.[183] In 1883 Billings observed that "the use of the library and museum by the medical profession of this country continues to steadily to increase...the amount of correspondence connected with this work may be inferred from the fact that over two thousand letters were sent out to fill the many requests for information, books etc. which

[182] Joseph Woodward, "The Medical Staff and the United States Army and its Scientific Work: An Address delivered to the International Medical Congress at Philadelphia." Sept. 6, 1876. P. 10.
[183] Incoming Correspondence OHA RG 13 (NMHM) Letters to John Shaw Billings Nov. 28, 1888 and March 7, 1888.

are constantly coming in."[184]In the absence of more structured medical repositories that could support medical research in postwar America, the AMM and SGL (later the NLM) proved important in institutionalizing some of the medical developments that resulted from the war. Barnes in an 1864 in a letter to Thomas Longmore, Professor of Military Surgery, Army Medical School at Netley, elucidated the challenge of wartime medicine but also the medical department's greatest achievement:

> With a system compressing nearly two hundred general hospitals, with eighty-six thousand beds extending from Maine to the Gulf of Mexico and from the Atlantic to the Pacific the evil is unavoidable, but we may claim as near an approach as to perfect accuracy as is possible in a work of so great a magnitude. In this connection the establishment of a "National Cabinet" has proved entirely successful, the collection of specimens and drawing of casts, illustrations of injuries and their results, has assumed a practical value hardly to be overestimated.[185]

It was noted in the *Lancet in* January, 1868 that medical practice during the war was both very "credible" but also interesting "in the pathological sense."[186]Similarly the *American Practitioner* observed:

> Those who know Dr. Billings' professional ability, zeal and industry need not be told how well he had executed his duty. In the advance which medical science is making, no inconsiderable part must be attributed more especially in reference to pathology and hygiene, to the medical department of the United States Army.[187]

The Museum had arguably one of its most profound effects on its first curator, John Brinton who went on to have an illustrious career, first as a lecturer at Jefferson College then as successor to Samuel D. Gross as Professor of the Practice of Surgery and Clinical Surgery, a position he held until 1906; he was also a visiting surgeon at St. Joseph's Hospital, Philadelphia Hospital and Jefferson College Hospital and gave several lectures and addresses during his life time.[188]Like many of his wartime colleagues he was a member of the Academy of Natural Sciences, the Pathological Society of Philadelphia, American Medical Association, the Philadelphia Surgical Club, American Surgical Association and the Philadelphia Medical Society. He helped develop *Lippincott's International Medical Magazine,* "A monthly devoted to medical and surgical science"

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[184] Data Relevant to the library in the annual reports of the Surgeon General MSC 185 (NLM) Box Three.
[185] RG 94, (NARA) Records of the Adjutant General's Office: Medical Records, 1814-1919 Entry 23, File D, Box 14 Letter from Joseph Barnes to Thomas Longmore Jan. 29, 1864.
[186] US Army Surgeon General's Office Correspondence (NLM) MSC7 Box One. Clipping of the *Lancet*, Jan, 1868.
[187] Ibid. Clipping from the *American Practitioner*, 1871.
[188] John H. Brinton Manuscript Collection. Otis Historical Archives RG 124, Box One (NMHM).

which boasted subscribers from Vienna, Berlin, Paris and London.[189] The war for Brinton was one of the highlights, if not the pinnacle, of his career. He had long had a fascination with bodies and death and developed his anatomical and physiological expertise during the war. In 1896 he recalled that "various departments moved forward" as a result of the war, especially "anatomy and physiology or the two together, have led the way to more logical and truer diagnosis, to be in turn followed by a broad medical treatment or a bold operative interference."[190] Brinton, however, like many Civil War physicians was frustrated not to have continued support for this development. After all states were not equipped with sufficient anatomy legislation in the immediate post-war period and this was once again problematic for physicians. The 1867 Anatomy Act of Philadelphia provided bodies to physicians but this was not without controversy, as Brinton observed:

> The attention of your board is respectfully invited to the facts that the interests of medical teaching in the city of Philadelphia is seriously threatened by the scarcity of suitable material for dissection, and that scarcity is yearly increasing. It is true that by the provisions of the Anatomy Act all unclaimed bodies of persons dying are turned over to the medical college of the state to be studied. But a large proportion of bodies from the hospital have been mutilated by destructive post mortem examination and can with difficulty be presented diminishing their value for anatomical teaching. Of 287 bodies from the Philadelphia Hospital, 167 were destroyed by dissection. And, the neck is recklessly destroyed to render the injection of preservative fluid difficult and often impossible.[191]

But attitudes about the study of medicine changed with the war and paved the way for the much needed reforms that would begin in the late 1870s.[192] Brinton highly valued his appointment as curator to the medical museum and was correct that his work there provided an enduring legacy, that the results of the "surgery of this war would be preserved for all time" and that the "education of future generations of military surgeons

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[189] Library of College of Physicians, John Hill Brinton Papers, 1853-1896 MSS 2/0269 01. Nov. 12, 1891 sent letters to physicians in America requesting submissions.

[190] John H. Brinton, Manuscript Collection OHA RG 124, Address to the Jefferson Medical College April 27, 1892. (NMHM)

[191] Library of College of Physicians, John Hill Brinton Papers, 1853-1896 MSS 2/0269 01. Letter from Brinton to the Board of Charities of Philadelphia, 1891.

[192] Many of the Civil War era physicians such as Mitchell, Keen , Brinton became advocates of anatomy reform and vivisectionists (especially Keen). For my next major study I plan to examine the period 1865-1900, which will allow me to further emphasize the impact of the war on the individual physician and for the continued development of the medical sciences in America. Elite war physicians did not necessarily go to Vienna and Berlin, they were awarded leading portfolios in America. How did they continue to shape science? How was the "Germ Theory" Received? Civil and military medicine is remarkably cohesive in this period—I would also like to elucidate this important relationship more fully.

would be greatly assisted."[193] In most of his post-war addresses he commented on the importance of the war experience for the education of both civil and military physicians.

One important way of understanding the effect of the war is the way in which individual physicians remembered it, simultaneously as an important period in their development as physicians and an unsurpassed educational intervention. Silas Weir Mitchell recalled the experience in 1913:

> It is a record to be proud of, or I should not so willingly revert to it. If you look for that story in the histories, they are silent; if you search for it in the countless autobiographies of soldiers great or small, these too are mute except as to what the soldier did. A few forgotten books by surgeons are personal or technical, and tell us little more than the baldest story of the individual. What else there is scattered through the huge volumes in the medical history of the war. We gain nowhere a sense of the immensity of the task in which as a profession we dealt with. We hear little or nothing of the unequaled capacity with which we met the call of energy and intelligence, of the extraordinary power of the trained American to deal with the unusual.[194]

He discussed some of the knowledge gained by his wartime service, such as improvements in hospital ventilation and the opportunity to develop pathological anatomy that had been anticipated by Hammond but most of all, his tremendous satisfaction in being able to develop his interest in nervous diseases.[195] Perhaps most poignant, he recorded the pervasiveness of the war for the medical profession in America:

> How far it taxed the average professional man of the cities—your city and mine—may be judged from the fact that in 1864 the living Fellows of the College of Physicians of Philadelphia were 174. Of these, 130 had been connected in one way or another with the service of the army or navy during four years of that bloody struggle.[196]

But he lamented in some ways that their contribution had not been better recognized:

> We had served faithfully; we had built novel hospitals; organized such an ambulance service as had never been before seen, contributed numberless essays on diseases and wounds, and passed again into private life unremembered, unrewarded servants of duty.[197]

But Mitchell's peers did view his medical contributions as fundamentally important. In 1914, Talcott Williams, President of Columbia University recalled his contribution to neurology:

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[193] Brinton, *Memoirs*, p. 181.
[194] Silas Weir Mitchell, *The Medical Department in the Civil War* Address Delivered before the Physicians Club of Chicago, Feb. 25, 1913. P. 3.
[195] Ibid.
[196] Ibid. p. 17.
[197] Ibid.

The Civil War came and opened to him, as it opened to many, the door of opportunity...He passed through these arduous years to find, as men often do, that the patient toil which he had given to the case of one soldier and another smitten by nervous maladies had spread his name abroad. ...We learn that the knowledge of his work and skill had gone to hamlets and towns where he could never have gone—and a wide public came to know that the practitioner's life had fruited in assuaging affections dependent upon the nerves. There flowed in upon him, as a result of the scientific intelligent use of large opportunity, such a practice as changed his life, and the income which had been so small in these days of struggle rose to figures which even in this day would be large, and there began for him that wider life and larger usefulness which we all know....The best known use he made of his new freedom was in medical research and discovery.[198]

Similarly, Keen testified:

In the years that have passed since then, other far abler surgeons, a younger generation have done more, better work. But while they have the joy and the rewards of their extensive and most important discoveries and improvements in diagnosis and technique, they never could have felt the thrill of those relatively few surgeons of my own age and generation who were among the first that ever burst into that silent sea.[199]

Silas Weir Mitchell was not the only physician who contributed to the development of scientific medicine as a result of the war experience. Dr. Gurdon Buck is largely considered the founder of modern reparative surgery, and the war was an important turning point for him. Buck published more than twenty-one articles and a monograph based on his wartime research, which was eventually translated into three foreign languages.[200] He outlined in detail his method of plastic surgery, particularly his success with pedicle flaps in trying to make the patient "whole" or "acceptable looking" and his methods were used and commented on frequently in the development of the specialty in the post-war period.[201] But perhaps most interestingly, prior to the war Buck had disapproved of specialties in medicine and agreed with Oliver Wendell Holmes who once described a specialist "as a person who has a vast amount of useless information."[202] During the war Buck saw both the need and efficacy of specialized knowledge and did much to pave the way for the development of medical specialization in American medicine.

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198 Talcott Williams, "Silas Weir Mitchell" in *S. Weir Mitchell: Memorial Addresses and Resolutions* (Philadelphia, 1914) pp. 87-88.
199 Keen, *Reminiscences*, p. 44.
200 Herbert Conway and Richard B. Stark, *Plastic Surgery at the New York Hospital One Hundred Years Ago* (New York: Paul B. Hoeber, Inc., 1953) p. 2.
201 Ibid.
202 Quoted in *Plastic Surgery at the New York Hospital*, p. 101.

Like Buck, Woodward also received world wide praise for his pioneering work in microscopy, photomicrography and cancer research, and his "publications in these fields made his name famous among scientists throughout the world."[203]Woodward along with George Otis and Joseph Barnes received much acclaim for the *Medical and Surgical History of the War of the Rebellion* and his other work related to Civil War medicine. He engaged in extensive research regarding disease and investigative methods during the war and he earned status through this work. His monograph, *Outlines of the Chief Camp Diseases of the United States Armies* was reviewed in the *American Journal of Medical Sciences* in 1864. The reviewer was generally positive and noted that "the uncommon opportunities belonging to his connection with the Surgeon-General's Office must give a higher authority to this book than would otherwise attach to it."[204]Woodward observed that some of his investigations were still being completed but even so the work was considered highly important. While some diseases had been seen in the European armies, there were also "some peculiar features in the disorders which have affected our soldiers."[205]The reviewer suggested that Woodward's pathological views were highly influenced by Virchow which "pervades in a certain sense the volume before us."[206]Less than three years after Virchow's treatise on cellular pathology was published, his doctrines were being consistently applied in Woodward's investigations. More importantly, Woodward encouraged other physicians to become familiar with Virchow's methods. This was very important for medicine's larger development. In 1861 the majority of physicians who performed autopsies generally focused on lesions and structural anatomy. As already demonstrated, the limitations of the morbid anatomy of gross lesions were realized very quickly and some physicians began to think of disease in terms of cellular pathology and the changes in cells within the body. This was the dominant medical system of Virchow, and because Woodward referred often to it, it became known among more American physicians than ever before. Moreover, the text was placed on the army medical supply table allowing physicians the opportunity to become practically acquainted with cellular pathology. Even more importantly, there was

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203 Kelly and Burrages, *American Medical Biography*, "Joseph Janvier Woodward."
204 Review of, J.J. Woodward's "Outlines of the Chief Camp Diseases of the United States Armies as Observed during the Present War." *American Journal of the Medical Sciences* Vol. XVLVIII (1864): 159-171.
205 Ibid, p. 160. Specifically, no typhus.
206 Ibid.

a dialogue about using the microscope to study tissue changes and disease processes. During the war physicians saw that disease processes were sophisticated and that the structure of the body or comparative anatomy would not alone elucidate disease processes. Woodward's monograph explained cellular theory in the context of Civil War camp diseases, and the war provided the bodies and hospital experience for physicians to monitor "cellular abnormalities in the body." Placing a primacy on the cellular changes in organs, particularly as they were studied under the microscope, laid an important foundation in which to both understand and develop bacteriological science.

Through the wartime work some physicians were able to achieve unprecedented status. Woodward often discussed the importance of research in medicine and through his own work showcased the potential or demonstrated the specific techniques of investigative medicine, which in turn promoted scientific industry.[207] There was a new generational cohesiveness that developed during the war that continued to evolve afterwards. In 1871 the *Richmond and Louisville Medical Journal* observed:

> Besides several important systematic treatises and monographs of interest, collections of hospital reports that have been published in the last five years, several courses of clinical lectures have appeared in print, and have added to the evidence that we are no longer entirely dependent upon foreign sources for knowledge of the progress of our art and science. The medical department has contributed its full share in this forward movement of medical literature.[208]

For many physicians the war became an integral part of their identity and the experience was referred to often in post war reminiscences and publicity. In 1867 the physician S. Bond advertised in the *Weekly Monitor* that he had served as a "late pathologist in the United States Army Medical Museum" and had "dissected and mounted most of the medical and pathological specimens" and "contributed a greater number of specimens to the museum than any one person." He added that a "long experience in the army in post-mortem examinations has given him superior advantages in that specialty." Woodward responded by writing a scathing letter to Joshua Riley, President of the Medical Association of the District of Columbia, to inform him that Bond's advertisement was an

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[207] And he was revered by some. He was given honorary memberships to numerous associations, asked to speak at medical conferences and he constantly received letters asking for advice. It is not an exaggeration to say that there are more than one thousand letters in the NMHM incoming correspondence (OHA 13) or Woodward's letterbooks (OHA 28) from physicians asking for his advice or to report interesting findings.

[208] US Army Surgeon General's Office Correspondence (NLM) MSC7 Box One. Clipping from the *Richmond and Louisville Medical Journal* Vol. XI Feb. 1871.

attempt to gain "notoriety by misrepresentation." He suggested that the advertisement was a "grave offence against medical ethics requiring the discipline of the association." He concluded:

> Bond never was in any sense a pathologist to the Army Medical Museum and he did not resign his position in the SGO's office which was that of a hospital steward but was discharged by reason of expiration of term of service, an application made by him for subsequent employment was declined. Hospital steward S.S. Bond enlisted September 16, 1864 for three years. He was employed for some time as an assistant to myself in mounting medical specimens for the museum; and while in this position made under my direction a number of autopsies at the Freedmen's hospital, bringing abnormal organs to me for analysis.[209]

Bond clearly valued his time at the AMM, and perhaps, given his years of service, Woodward was ungracious, but the advertisement reveals that the expert status conferred through the wartime medical work was highly valued. Similarly, when Barnes was incorrectly given credit by the Adjutant General's Office with the inauguration of the *Medical and Surgical History of the War* and the Army Medical Museum, Hammond wrote a lengthy and heated demand for credit to the Adjutant General:

> There are few things in my professional career that in which I take more pride than the ideas of the Army Medical Museum and the *Medical and Surgical History of the Rebellion* were conceived by me, and that both were in successful operation when Barnes succeeded to the Office of the Surgeon-General.[210]

Hammond went on to have a very successful and highly profitable neurology practice in New York[211]but his most enduring legacy to medicine was the military reforms he initiated during the Civil War and which contributed so much to the development of American scientific medicine.

These medical reforms were so important because the war came along at a particularly challenging period for the U.S. medical profession. Historians generally frame nineteenth century medical development as three broad but overlapping shifts: rationalism, to empiricism and anti-rationalism, and back to rationalism.[212]But this shift

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209 Woodward's Letterbooks Otis Historical Archives RG 28 (NMHM) Letter from Woodward to Joshua Riley, Oct. 5, 1867.

210 The Official Correspondence between Surgeon General William Hammond and the Adjutant General of the Army Relative to the Founding of the Army Medical Museum and the Inauguration of the Medical and Surgical History of the War" (Appleton and Co.: New York, 1883). p. 6.

211 See Bonnie Ellen Blustein, *Preserve Your Love of Science: Life of William A. Hammond American Neurologist* (New York: Cambridge, 1991)

212 See for example, John Harley Warner, *Against the Spirit of the System.*

from empiricism to rationalism after mid-century took shape during the war. Science was no longer merely empiricism but neither was it laboratory medicine either. Ideas about medicine and disease were in flux, in some cases owing to the wartime medical challenges. As traditional ideas about medicine and disease came under scrutiny or were found to be remarkably ineffective, some physicians responded with new methods of investigation; they published their findings or research questions and it was common to invite other researchers into the field. There was a new mind set about how to manage and investigate disease that developed during the war. Hammond's reforms, beginning with Circular No. 2, paved the way for medical study and practice to develop.[213]But the limitations of pathological anatomy were fairly quickly realized, which prompted some physicians to develop newer investigative tools such as histology, microscopy, chemical analysis of disease processes and physiology foreshadowing the importance of laboratory medicine. It was not the medicine of Germany where laboratory courses were taught by full time researchers or medical doctors; rather wartime medicine was one stage in the larger development of scientific medicine. The most important effect of medical practice during the war was that it stimulated, even demanded new approaches to medical study; and as a result attitudes about the efficacy of scientific medicine changed, though clinical medicine was never abandoned by Civil War era physicians.[214]There was an enduring idea among this generation of doctors that knowledge produced away from the patient should still practically benefit the individual; they had seen the efficacy of this model during the war. Clinical research dictated the types of questions physicians were asking and influenced the way in which medicine was investigated. But there was a new commitment towards developing medical science and physicians, both consciously and subconsciously, allowed it to enter their clinical work. Moreover physicians continually referred back to the importance and value of this early work while suggesting ways in which their efforts could continue to shape medicine:

> Now the museum is a valuable site for teaching lessons of the past and future, for example, the pathological conditions of most of the diseases and injuries. The wet specimens show the lesions which marked so-called typho-malarial fevers. Study these

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[213] Paris=Pathological Anatomy; Civil War=Pathological Anatomy + Physiology and newer investigative tools to understand disease processes; Germany= physiology + bacteriological science—the search for causative germs, separate from the patient in the laboratory.

[214] In the second half of the century clinical medicine was scientific medicine to the American physician-–and it would be for the rest of the century.

> preparations in light of our recent knowledge of sepsis and bacteriology. Professors in your school will tell you to use knowledge we never had....Now thanks to Joseph Lister and the outcomes of his teaching the limb fares otherwise. But the past helps us judge the present and perhaps foresee the future. Ways to study, extract information and publish what is important and what is not. But each generation is expected to know more than their predecessors.[215]

It is not the intention of this thesis to assert that all wars are good for medicine but rather that the Civil War came at a crucial stage in the development of American medicine, allowing physicians to become conversant with pathological anatomy, providing an unprecedented focus on disease and patients and a growing objectivity in medical study. But then elite physicians, European trained or inspired, had long wanted to develop scientific medicine and the wartime culture supported this intellectual current, leading to innovations in the management of disease, diagnoses, experimental medicine, research societies and a newfound respect for the physician in charge of a specialty hospital. Indeed, one of the most important aspects of Civil War medicine was its support for new epistemological standards in medicine, a shift which deserves close attention. What constituted medical knowledge? How was knowledge acquired? How did knowledge develop? How was this knowledge transmitted? The medical experience of the war and the increasing emphasis on scientific medicine was most pronounced in five important areas: medical practice and the way in which disease was understood, diagnosed, investigated and prevented. Moreover these developments were structured even institutionalized because there was a powerful mechanism to ensure that the knowledge was transmitted, creating a community of physicians who could benefit from the networks of knowledge developed during the war. But the "ways of knowing" were multi-factorial. Every physician was encouraged to contribute to the national pathological museum and provide either analysis or descriptions of their medical cases, while some were asked to conduct specific investigations into a range of diseases, which often prompted new styles of scientific investigation and experimentation.

These differing perspectives, or rather the varied attempts to develop medical knowledge elucidate the dynamic atmosphere in which Civil War physicians functioned, and provide insight into the development of scientific medicine in the later nineteenth

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[215] John H. Brinton Manuscript Collection OHA RG 124 John H. Brinton, Address to the Members of the Graduating Class of the Army Medical Museum, 1896. (NMHM)

century. There remained of course many physicians who never looked through a microscope or engaged in research projects and were content with the more traditional clinical exam and the production of empirical knowledge. But there was also an unprecedented number who wanted to engage in scientific medicine and in the process a new language permeated medical circles and publications. These physicians produced medical knowledge by studying the minute structures of disease processes, the blood, urine, tissues and organs in detail and in a physical location away from the living patient, as in the investigations related to gangrene, erysipelas and cholera which changed basic assumptions about where to study disease. But living bodies were also used to develop medical knowledge, as seen in the investigations relating to heart disease, neurology, malingering, prosthetic development, surgical approaches, diagnostics and therapeutic trials which not only changed basic assumptions about how to study disease but also how to structure medicine. For example, as some physicians saw their own limitations in managing disease, others were encouraged to develop their interest in a particular class of disease and published their findings and methodology, which laid a foundation for medical specialism. The physicians both stimulated and excited by this work, often consulted with each other during their investigations, creating a dynamic medical environment in America.

This study argues that understanding the complex questions that physicians faced during the Civil War, the response to these challenges and finally, the way in which this knowledge was produced and then transmitted, was a crucial stage of physician development in the nineteenth century. The context of what constituted scientific medicine continued to evolve in the post war period and Civil War physicians were important actors in this process—both cause and beneficiary of these larger changes. Somewhere along the way, their efforts to develop scientific medicine have been lost or downplayed in the larger narrative of nineteenth century medicine, and in accounting for the medical developments in the later century most of the attention has been lavished on the next generation of physicians that studied in Vienna and Berlin. It is true that the Civil War did not produce one "great man," which has perhaps made it difficult to see the importance of the war for medicine as a whole. There was no Pasteur, Koch, Davaine, Schwann, Bichat or Virchow that emerged from the Civil War hospitals and laboratories.

The war's impact was different—it had an important even transformative effect on the numerous physicians who took advantage of the opportunities and together helped to shape medicine in America. Many Civil War physicians went on to assume leading roles in their profession, others engaged in lively correspondence with young physicians (such as Woodward and Welch; Billings and Osler or Keen and Cushing); still others continued to develop their new specialties in the post war period. Whatever the specific path, the war experience was an important part of the individual physician's medical identity in the later nineteenth century. Physicians developed this medical identity in a variety of ways and processes: through the collection and dissection of bodies and specimens, as specialists or extensive knowledge of specific diseases, or their wartime medical publications.

John Brinton recalled in 1865:

> On the 9th of April, 1865, General Lee surrendered the Army of Northern Virginia, and the war was practically at an end. The news was telegraphed from Washington about ten o'clock in the evening, and our city was notified by the screeching of the whistles of the fire engines and by clamor and noise of every imaginable character. The War was over. The great experiment had been made. It had been definitely proven that the United States was a Nation.[216]

So too was the American medical profession on a new course. The evaluation of the Civil War case histories, medical and surgical specimens on display or in jars in the museum, publications, correspondences and wartime reminiscences all reveal that the experience of the war had contributed to a distinctly American medical identity for many physicians and provided an important stimulus for the development of newer, more scientific standards in American medicine.

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[216] John Brinton, *Personal Memoirs of John Brinton* (eds) John Simon and John S. Haller (Carbondale: Southern Illinois Press, 1996) p. 351.

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Appendix One: Summary of Two Thousand Six Hundred and Forty Two Cases of Gangrene, indicating result and relative frequency[1444]:

Seat of Injury	Recovery	Fatal	Undetermined	Fatal	Percent	Percent of relati uency
Head, face,ne						.2%
Fractures and penetrating wounds of head, face, and neck	32	16	n/a	48	33.3	60=2.2%
Flesh wounds of trunk	36	32	7	75	47	216=8.2%
Fractures and penetrating wounds of trunk	44	97	n/a	141	68.7	216=8.2%
Flesh wounds of the upper extremities	47	50	12	109	51.5	2366=89.6%
Fractures of the upper extremities	476	245	14	735	33.9	2366=89.6%
Flesh wounds of the lower extremities	125	127	92	344	50.3	2366=89.6%
Aggregates	1361	1142	139	2642	45.6	

Appendix Two: Numerical Statement of 1097 Cases of Traumatic Erysipelas[1445]:

Seat of Injury	Cases	Recovery	Fatal	Undetermined	Regional Percentage
Head, neck, face	154	107	44	3	14
Trunk	57	23	33	1	5.2
Upper extremities	457	259	180	18	41.7
Lower extremities	429	229	193	7	39.1
Aggregates	1,097	618	450	29	

[1444] Medical and Surgical History; Volume II, Part III p. 824.
[1445] Ibid. pp. 852.

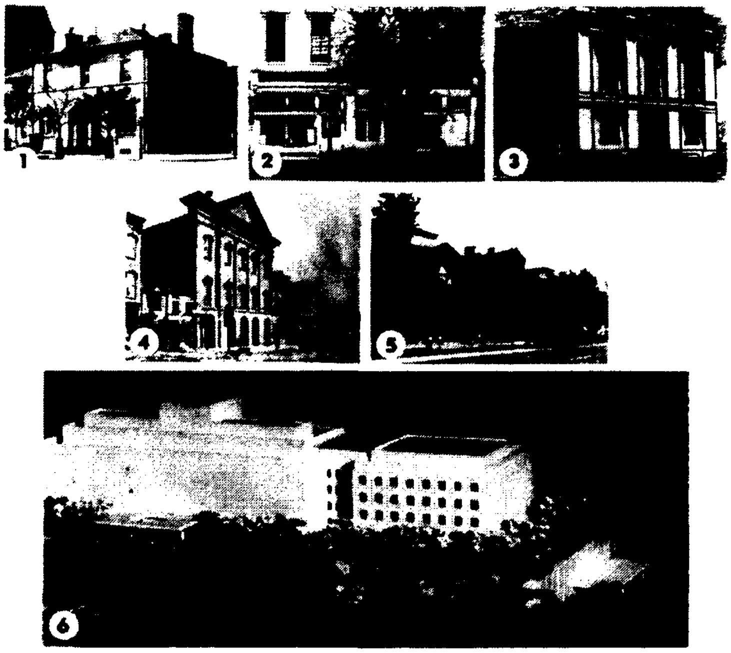
Appendix Three: Summary of 334 Cases of Hospital Gangrene, giving treatment and results[1446]:

Treatment	**Total Cases**	**Recovered**	**Died**	**Amputations**	**Duration of Treatment**	**Percentage of Mortality**
Treated with Bromine in different ways	152	148	4	n/a	5 days 14 hours	
Treated with pure bromine exclusively	27	25	2	n/a	2 days 22 ½ hours	
Treated with pure bromine in solution exclusively	86	84	2	n/a	6 days 11 1/3 hours	
Treated with pure bromine after the solution failed	8	8	n/a	n/a	12 days 16 hours	
Treated with pure bromine after nitric acid failed	23	22	n/a	1	3 days 16 1/3 hours	
Treated with bromine after other remedies failed	8	8	n/a	n/a	2 days 4 hours	2.6 total
Treated with nitric acid exclusively	13	5	8	n/a	3 days 14 2/5 hours	61.5
Treated with other remedies exclusively	13	7	5	1	7 days 13 5/7 hours	38.8
Treated with other remedies after bromine failed	4	4	n/a	n/a		
Aggregates	334	331	21	2		6.2

1446 *Medical and Surgical History of the War Volume 2, Part 3* p. 836. Goldsmith's statistical summary of 334 "well authenticated cases of gangrene treated at the military hospitals at Louisville, Kentucky, Nashville and Murfreesboro, Tennessee, New Albany and Indiana.

Appendix Four:
(photo courtesy of the National Museum of Health and Medicine)

HOMES OF THE MEDICAL MUSEUM



1. Riggs Bank Building, Pennsylvania Ave. and 15th St., N.W., 1862-63.
2. 180 Pennsylvania Ave., N.W., 1863.
3. Corcoran School House, 1325 H St., N.W., 1863-66
4. Ford's Theatre, 511 10th St., N.W., 1867-87.
5. The "Old Red Brick", 7th St. and Independence Ave., S.W., 1888-1968.
6. Model of the future home in the new south wing (portion with windows) of the AFIP building now under construction.

Curriculum Vitae

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Selected Conference Presentations and Invited Talks:

"Whose Bodies? Military Bodies and the Politics of Ownership during the American Civil War, 1861-1865." Annual Meeting of the Society for the Social History of Medicine, Northern Centre for the History of Medicine, Newcastle and Durham (UK), July 8-11, 2010

"Is War Good for Medicine?: The American Civil War and the Development of the Medical Sciences in the Nineteenth-Century." The Annual Meeting of the Society for Military History, May 20-23, 2010 Lexington, VA hosted by the Virginia Military Institute and the George Marshall Research Library

"Research, Bodies and the Development of Experimental Method: Septic and Zymotic Diseases during the American Civil War, 1861-1865." Human Experimentation Workshop, Diefenbaker Centre, University of Saskatchewan, October 23, 2009. Part of the "Situating Science, SSHRC funded Strategic Knowledge Cluster."

"Investigative Medicine and the Idea of Experiment in Nineteenth Century America: Gangrene and Erysipelas during the American Civil War," Annual Meeting of the Canadian Society for the History of Medicine, Carleton University, Ontario Canada May 28-31, 2009

"The Development of Scientific Medicine in the Nineteenth Century: Medical Practice during the American Civil War," Annual Meeting of the American Association for the History of Medicine, Cleveland, Ohio, April 23-26, 2009

"Science in the Practice of Medicine: Case Study of infectious diseases during the American Civil War," Annual Conference of the History of Military Medicine and Health Care, Army Medical Services Museum, London, England, April 15-17, 2009.