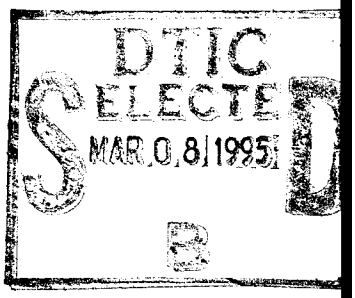
THE EVOLUTION OF PREVENTIVE MEDICINE IN THE UNITED STATES ARMY, 1607–1939

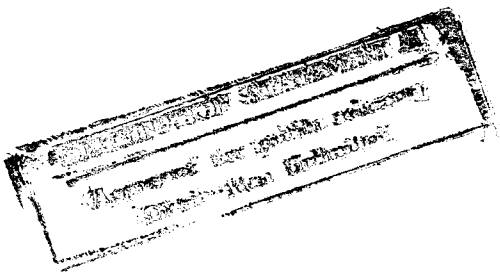
STANHOPE BAYNE-JONES, M.D.



Prepared and published under the direction of
Lieutenant General LEONARD D. HEATON
The Surgeon General, United States Army

Editor in Chief
Colonel ROBERT S. ANDERSON, MC, USA

OFFICE OF THE SURGEON GENERAL
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 1968



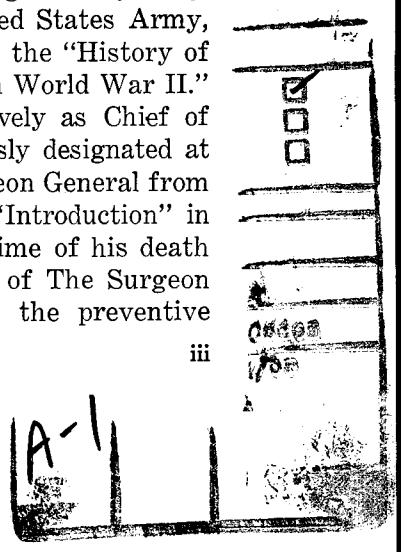
Library of Congress Catalog Card Number: 60098

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402—Price $2.50

Preface

Historical books, monographs, and articles on the subject of military medicine have been devoted largely to exposition of medical administration and the care of the sick and wounded. They have allocated only small quarters to the history of preventive medicine. It is not astonishing, therefore, that medical officers, including preventive medicine officers, not having the time or opportunity to seek for the scattered and scarcely available sources, have been somewhat restricted in comprehension by a lack of information about the origins and developments of the principles and practices designed to prevent disease and preserve the health of soldiers. Since civilian and military medicine are so closely related, influencing and enriching each other by discoveries and exchanges, the knowledge of the backgrounds of both public health and preventive medicine is essential for enlightenment and understanding. It is the aim of this monograph to bring a certain amount of past experience into present consideration, to demonstrate beginnings and continuities. Although this is an unofficial historical narrative and analysis, *not* a manual, it is hoped nevertheless that it will be of collateral value in training programs.

The title is a modification of a heading used by Brig. Gen. James Stevens Simmons, MC, United States Army, in a draft of his chapter introductory to the "History of Preventive Medicine in the U.S. Army in World War II." Having served vigorously and imaginatively as Chief of the Preventive Medicine Service (variously designated at different times) in the Office of The Surgeon General from 1940 to 1946, he began to prepare his "Introduction" in 1948. The draft was unfinished at the time of his death on 31 July 1954. In 1961, by an action of The Surgeon General's Advisory Editorial Board on the preventive



medicine history, the responsibility for the first volume, and other parts of the history, passed to me as the successor-chairman of that Board. As familiarity with the subject increased, my ideas enlarged; and, in 1962 when I began writing, I saw the need and possibilities of a new composition, differing from the older, usually reiterated paraphrases of previous reviews, by utilization of original sources. I outlined a treatment of the subject which would begin with the armed colonists at Jamestown in 1607 and continue through 1939 when preparations for the possible entry of the United States into World War II in alliance with Great Britain were well advanced. One might ask: Why begin with the year 1607 to tell the story of the evolution of preventive medicine in the United States Army when no such Army existed until 14 June 1775? As some of the elements of the programs are to be found in the writings of ancient Egyptian, Jewish, Greek, and Roman authorities, why not go back to antiquity? Except for brief allusion to the Mosaic sanitary code, respect for antiquity did not seem to me to require inclusion of such ancient material in an article focused upon the American Army. There are several reasons for the decision to display some events of the 168 years preceding the beginning of the American Revolutionary War. The colonists as individuals, or as militiamen, fought in British ranks in all of the wars of the colonial period that were conducted periodically on American soil during somewhat more than a century and a half. In the battles, marches, and encampments, these men learned by experience the principles and practices of British military sanitation, hygiene, and preventive medicine under such great surgeons general as Pringle and Brocklesby. The knowledge thus acquired became, in time, a code for the Revolutionary Army. In addition, a number of those who served with the British in the decades immediately before 1775 became important officers in the Medical Department of the Continental Army, and also in the line of the Army itself. Thus, British (and also some French and German) policies, disciplines, and methods passed from foreign systems into American

organizations. Many of the basic principles and some of the activities of those times are currently applied in the United States Army today. From nearly all of them there is illumination.

I began to work on the "Introduction" in January 1962, and finished the first draft in March 1966. In June 1964 I moved from The Historical Unit, United States Army Medical Service, to The National Library of Medicine where, thanks to the hospitality of the Director, Dr. Martin S. Cummings, I was assigned a study room—a carrel in the midst of bookstacks—which placed me physically at a center of the desired lore. I had access to the great general and medical history collections of the National Library of Medicine, which from 1836 to 1956 was the Library of the Office of The Surgeon General of the United States Army. I had access also to the collections in the Rare Book Division of the Library of Congress. In both of these libraries, all the important pertinent literature of the 17th and 18th centuries was available, and, of course, 19th and 20th century material, in the form of books and journals, was abundant on the shelves. Of archival material, the General Reference and Research Branch of The Historical Unit and the National Archives and its subsidiary storage units generously supplied anything requested, provided it existed in their files. For the older regulations, reports, and many items, the Document Section of the National Library of Medicine, which had preserved the documents collected by former Army Surgeons General and their Librarians, was the richest possible vein of such information, hitherto only partly explored for historical purposes. Valuable service was received also from the Army Library in the Pentagon.

The draft of my introductory chapter was read by all members of the above-mentioned Advisory Editorial Board, and by others, including Dr. Stetson Conn, Chief Historian of the Army, in the Office of the Chief of Military History. They were appreciative and gave me valuable criticism. One of this group, Dr. Conn, was the first to suggest that with suitable revision this monograph might

be published separately. That plan was approved by the Advisory Editorial Board and by the Director of the United States Army Medical Service Historical Unit. During 1966 and 1967, official approval for such publication was granted by the Office of The Surgeon General and the Office of The Adjutant General, Department of the Army. These approvals do not diminish my responsibility for this text. Except in cases of documented citations and quotations, I am responsible for interpretations made and conclusions drawn, and for any errors of omission or commission.

Having had an interest in military and civilian preventive medicine extending practically throughout my life, from ancestral influences, schooling, and civil and military-medical occupation, I can recall numerous persons, episodes, and experiences all helpful toward the production of this monograph. Primarily, I owe much to my former Chief of the Preventive Medicine Service, the late Brig. Gen. James S. Simmons, and to the brilliant groups he gathered together for the solution of problems and for promotion of the health of the Army both in the United States and overseas in World War II. To name all to whom I am indebted in this connection would be impossible. Even to name all who contributed significantly to the accomplishment of this work would require an excessive amount of space. A special debt is owed to Mrs. Pauline B. Vivette, Assistant Chief, Editorial Branch, The Historical Unit. She collaborated with me in revising a draft of this writing, checked all of the references by inspection of the cited volumes, journal articles, and quotations, and edited the manuscript with experienced skill. Grateful acknowledgment is also made to Miss Janie W. Williams, Chief, Publication Section, Editorial Branch, The Historical Unit, who edited the artwork and the legends with very special care.

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Introduction

PRINCIPLES, OBJECTIVES, PROGRAMS

Preventive medicine programs for armies, from antiquity to the present, have been designed and operated to prevent physical and mental diseases and disabilities, and to preserve and promote health among all personnel essential to the military effort. With varying degrees of potential efficacy, conditioned by the state of knowledge and by the enterprise of leaders and their followers, these programs have provided for the application of measures of control not only in strictly military situations but also in civilian populations in the environment of war areas when conditions in such groups were threats to the health of troops or possible hindrances to the progress of campaigns. These programs have been, and must be, intelligent combinations of measures which rest upon the responsibility of the individual person and of public health activities which are the responsibility of the community. Military preventive medicine is in fact the public health of the community of the Army.

Like civilian preventive medicine, military preventive medicine is the total of all those activities projected to keep well people well, or, as is so often said in the Army situation, to keep the soldier fit to fight. To this end, in the modern view, health is regarded as a positive thing, not to be expected as a gift of nature or of God, but something that must be fought for and cherished regardless of cost in order to maintain the fighting efficiency of the Army. Furthermore, as prevention is so much less expensive than curative medicine demanded by outbreaks of

disease, a good control program, well operated, saves large sums of money and averts enormous economic losses.

ARMY STRUCTURE AND GOVERNMENT

For insight into the characteristics and operations of military preventive medicine, attention must be paid to the influences exerted by the Army's structure and composition, and by its mission, government, and procedures, as clearly pointed out by Lt. Col. (later Maj. Gen.) George C. Dunham, MC, USA *(1)*. Military authority greatly facilitates the practice of preventive medicine. In the disciplined force, compulsory regulations compel obedience and drive action, although regulations do not entirely take the place of explanation, persuasion, and agreement. A knowledge of the military environment in which the principles of preventive medicine are to be applied is essential to successful practice. Conditions in military situations which modify civilian preventive medicine are mainly those resulting from the following: (1) the characteristics peculiar to a military population of enlisted men (males in the 20- to 30-year age groups); (2) concentrations of men and crowding; (3) the primitive environmental conditions of the field; and (4) the restrictions imposed by the military mission, as when strategic and tactical considerations override sanitary doctrine and requirements.

Important as are these and other Army affairs, it has never been sufficient for a military preventive medicine organization to be merely Army centered. It is necessary for the vitality and progress of the preventive medicine organization that the closest possible association and cooperation be maintained with every significant institution or body—laboratories, medical schools, universities, and public health departments, at home and some abroad—concerned with biology and medicine, chemistry, physics, and, in general, with both the natural sciences and the social sciences. Such institutions can contribute to the Army highly important informed advice, expert personnel, and a long range of facilities.

MEDICAL DEPARTMENT JURISDICTIONS

As the Medical Department of the United States Army has never had executive powers outside of its own units, its preventive medicine officers and representatives have served as advisers to line officers—the military commanders upon whom has rested the final responsibility for the health of their commands. This has been so from General Washington to General Marshall, from Dr. Shippen to Dr. Kirk, and from Dr. Benjamin Rush to Dr. James S. Simmons. In certain instances, however, limited and special command functions among troops in the line have been delegated to preventive medicine to be performed by a variety of specialists. It is to be noted, additionally, that, through the performance of its inspectorial, advisory, and recommendatory duties, military preventive medicine is concerned with the administration of the whole Army. Consequently, its scope exceeds that of all other parts of the Office of The Surgeon General. When its recommendations are approved by the War Department (more lately the Department of the Army), they have the force of highest Army authority. For example, all sanitary regulations and regulations for the preservation of the health of troops Armywide, are, according to a practice as old as the Army itself, issued by order of the Secretary of War (nowadays by order of the Secretary of the Army) over the signature of the Chief of Staff, or The Adjutant General, or other appropriate officer. Thereby, these regulations are directly binding upon Army personnel. An appreciation of these functions, relationships, and procedures is necessary for a true understanding of the place and powers of preventive medicine in the United States Army.

STATE OF THE ART

Equally essential to the soundness of a program is the state of biological, medical, and scientific knowledge, the so-called "state of the art." From the vantage ground of

today's sophistication, it is seen that most of the wars in man's history, prior to about 1900, were fought without benefit of scientific preventive medicine. Although this is true, it connotes a belittlement of the intellectual content of the past. Accounts of sound ideas and salutary empirical practices are to be found in the history of military and civilian preventive medicine from antiquity onward. Before the "bacteriological era," however, beginning in the last quarter of the 19th century, the key to the puzzle was missing. There was no experimentally verified knowledge about micro-organisms as causes of communicable diseases, or about vectors, intermediate hosts, and carriers of infectious agents. Without this knowledge, definitive protective measures could not be devised.

Nevertheless, there prevailed among people, their physicians, and military commanders, many sensible and practical ideas, which, if they had been applied rigorously, would have prevented much sickness and many deaths, even in the colonial era and in the years before Pasteur and Koch. By various routes, elements of this folklore became incorporated in the doctrines and practices of preventive medicine in the United States Army. The number and importance of these elements, constituting most of the basic principles, are impressive. They might be reviewed at length; but since Garrison *(2)* and others have written much about them, there is no need to recapitulate the precolonial details, except for a special note to be made later (p. 33) on the Mosaic sanitary code, which influenced British and American military surgeons and line officers including George Washington.

PERIOD COVERED

As pointed out in the preface, medical and military events of the 17th and 18th centuries in England, in the American Colonies, in the American Revolutionary War, and in the first years of the Republic, furnished many of the ingredients of the program of military preventive medicine with which this volume is concerned. This period of

192 years began with the founding of the English colony at Jamestown, Virginia, on 14 May 1607 and ended in 1799 *(3)*.

The narrative of the whole span of 332 years, from Jamestown in May 1607 to the outbreak of World War II in Poland on 1 September 1939, may be divided into sections, parts, or chapters in various ways, depending on the intentions of the writer. There is no fixed paradigm for chronological division. In any case, the divisions are bound to be arbitrary. A division into parts based chiefly on the occurrence of wars within the period seemed a natural arrangement to the author who, like many others, is impressed by the evidence that, as one reviewer expressed it, "wars have regularly sparked an upsurge in preventive medicine knowledge and practice." Such a division conforms also with related civil events, such as the sanitary movements and reforms of the mid-19th century which were quickened by the Crimean War and the American Civil War. Therefore, this volume has been divided into parts composed of combined accounts of significant events in military preventive medicine and civil public health, with an attempt to correlate research and the advancement of knowledge with Army medical and sanitary affairs, and to furnish examples of the utilization of medical and scientific knowledge.

PART II

The Colonial Period (1607-1775)

Approach to an account of the beginnings of preventive medicine in America in the colonial period—an approach appropriate also to the first three quarters of the 19th century—is animated by the appraisal and sentiment expressed in another connection by Dr. Vannevar Bush *(4)*:

> A review of the mode of living of our forefathers, if it is to be useful, should be sympathetic in its attitude. The lapse of time often obscures the difficulties surrounding a former generation, and we are apt to smile at crudities when a just estimate should rather leave us to marvel that so much was accomplished with so little.
>
> It is especially pertinent that we should review the technical accomplishments of another period only in the light of the contemporary science. Otherwise, we may well be guilty of a patronizing complacency, and as a result lose the benefit to be derived from a really analytical view of history.

PREDOMINANCE OF ENGLISH SOURCES

The sources of prevailing ideas and examples of preventive medicine practices were essentially English. This was but natural. Colonial North America was an English possession and the population was predominantly British in origin. As Blake *(5)* has pointed out: "By and large they [the Colonies] had the same language, the same religion, the same inheritance of British social and political ideals. And by and large they had the same diseases."

In his characterization of the colonial times, Col. John van Rensselaer Hoff *(6)* emphasized the same point as follows:

> From the beginning of the settlement of our country there was conflict not only between man and nature, but between man and

man. Every settler from the force of circumstances became a soldier, and while organization for military purposes was necessarily of the simplest character, there was such organization, and doubtless the medical man was a factor in it. As the population grew, the little wars took upon themselves more definite form, the more venturesome of the people organized themselves into bands or companies, and from time to time regular troops were sent from the mother country, with the organization then recognized as most satisfactory.

With the outbreak of the War of the Revolution all that our people knew of military affairs came from the British, and it was not unnatural that such organization as was contemplated for the American army was modeled on that of their foes.

EUROPEAN WARS IN AMERICAN COLONIES

Some of the "little wars" referred to by Colonel Hoff were fierce battles with the Indians; others were the colonial phases of large and prolonged European conflicts *(7)*.

For these campaigns, the Colonies furnished unknown thousands of soldiers, millions of dollars, and large amounts of supplies. It has been stated that in the last intercolonial war, the provincial troops lost 30,000 men by disease or in battle *(8)* "—chiefly by disease, no doubt." Apparently, nothing new or important was contributed to military preventive medicine from the experiences of these wars. On the other hand, several men who became important in directing military hygiene in the Army of the United States in the American Revolutionary War were developed in these earlier wars (for example: John Morgan, John Jones, and above all, George Washington). In addition, according to Hindle *(9)*:

* * * The most specific influence followed from the military experiences American physicians and surgeons had shared during the French and Indian War, which brought them in contact with British military medicine. The eyes of many were opened, especially of those who had had no academic training. They were exposed to a much better trained and organized profession in which certain standards of performance were insisted upon. All the Americans came to recognize more clearly their need of better education and

of regulations which would bar the incompetent from practice. War experiences coupled with post-war patriotism and enthusiasm for organizing led to surprising activity.

BRITISH AND EUROPEAN MILITARY PREVENTIVE MEDICINE

In Western Europe from 1740 to 1763, during the War of the Austrian Succession and the Seven Years' War, two great English Surgeons General, Sir John Pringle and Dr. Richard Brocklesby, consolidated doctrine and advanced military hygiene. They, and others, published in books their observations, conclusions, and recommended regulations for the preservation of the health of troops. Although these publications had little or no immediate influence upon military hygiene in the American Colonies, which at that time did not have a constituted army, slowly, within the decade and a half preceding the American Revolutionary War, these writings and teachings became known and available in Boston, New York, Philadelphia, and Charleston, South Carolina. The period from 1760 to 1775 was indeed a remarkable one in the history of American medicine in general and in relation to developments in military preventive medicine. As McDaniel *(10)* has stated:

* * * During this period there returned to the Colonies of Pennsylvania, Massachusetts, Virginia, New York, Maryland, and South Carolina, armed with the Edinburgh M.D. degree, a group of young and ambitious physicians including such later distinguished medical figures as William Shippen, Jr., Benjamin Rush, John Morgan, Samuel Bard, Adam Kuhn, Arthur Lee, Gustavus Brown, Peter Fayssoux, and Walter Jones.

There were others: notably John Jones and Benjamin Church. Of these, Shippen, Rush, Morgan, Church, and John Jones held high and responsible positions in the Medical Department of the Army during the Revolution and were directly concerned with military hygiene during campaigns. They knew Sir John Pringle personally and had attended his medical dinner club meetings in London. Thus, they became familiar with ideas and practices of the best British military preventive medicine of the time.

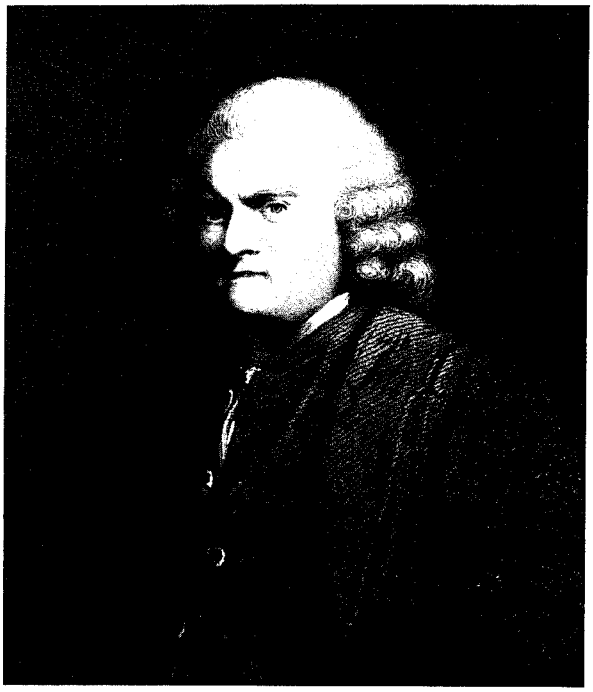

FIGURE 1.—Sir John Pringle (1707–1782), founder of modern military preventive medicine and originator of the Red Cross concept; Surgeon General of the British Army, 1742–1758. He influenced the training of American physicians and surgeons who served in the Continental Army during the American Revolutionary War. (Portrait by Sir Joshua Reynolds, painted in 1775 (expression said to be unduly acidulous), copied from engraving *in* Pettigrew, T. J.: Medical Portrait Gallery * * * London & Paris: Fisher, Son, & Co., 1839, vol. II, 14th memoir. Courtesy of the Library of Congress.)

Sir John Pringle.—Sir John Pringle (1707-1782) (fig. 1), the founder of modern military medicine as distinguished from military surgery, and the originator of the Red Cross concept, studied medicine at Leyden under Boerhaave and Albinus. In 1742, several years after his return to England, he was appointed Surgeon General of the British Expeditionary Force in Silesia in the War of the

Austrian Succession. He was physician to the Earl of Stair, commander of the British forces on the Continent. It was through the Earl of Stair, at about the time of the battle of Dettingen in Bavaria in June 1743, when the army was encamped at Aschaffenburg, that Pringle brought about an agreement with the Duc de Noailles, the French commander, that the military hospitals on both sides should be considered as neutral, immune sanctuaries for the sick and wounded, and should be mutually protected. The International Red Cross, as constituted by the modern Geneva Conventions, developed from this conception and agreement, providing for not only humane treatment, but also a program for preventive medicine for prisoners of war, both sick and wounded, and able-bodied *(11)*.

Pringle reformed military medicine and sanitation. Drawing upon his large experience in military hygiene, reinforced by systematic observations and research, he produced in 1752 *(12)* his "Observations on Diseases of the Army." This book soon became the most important book on military medicine of the time; and, as many of its elements have been incorporated in succeeding manuals and regulations, it has infused 20th-century writing on the subject. It contains, in fact, most of the principles and recommended preventive medicine practices of the present, except, of course, those that are based upon a knowledge of microbial causes of disease, of arthropod vectors and carriers—knowledge which was not experimentally determined until somewhat more than 100 years after Pringle wrote.

Pringle laid down rules of personal hygiene for soldiers. He emphasized the importance of adequate ventilation of barracks and hospital wards. He specified the essential requirements for proper clothing, for avoidance of overcrowding, for mitigation of exposure to heat, cold, wetness, and fatigue. Cleanliness, above all, was a requisite in his sanitary code, which comprehended the disposal of wastes of all kinds, the construction and care of latrines — "necessaries," as they were called — the selection of

campsites, the policing of camps, and the supervision and control of rations and drinking water. One of his associates in the period 1740 to 1748, in a campaign in the Netherlands, Francis Home (1719–1813), secured the issuance of an order that *(13)*: "The dragoons shall drink no water without it be first boyled."

In a summary comment in his "Notes on the History of Military Medicine" (p. 149), Garrison stated: "Pringle—showed that jail fever and hospital fever are one and the same [later recognized as epidemic louseborne typhus fever]; did much for the better ventilation of shops, barracks, jails and mines; correlated the different forms of dysentery; and gave the name influenza to that dread disease. This work [the "Observations"], the source-book of all subsequent writers, was followed by Van Swieten's book on camp diseases (1758), and Richard Brocklesby's observations on military hospitals (1764)."

James Lind and scurvy.—At about the same time, the classical treatise *(14)* of James Lind (1716-1794) appeared concerned with scurvy and its prevention and cure by the inclusion of citrus fruits, or juices of oranges, lemons, or limes in the diet (fig. 2). This preventive measure, developed by Lind, among sailors also was applied among soldiers during the Revolutionary War.

Pringle's influence upon American civilian and military medical men was direct, personal, and literary. During Benjamin Franklin's stay in England on his first foreign mission from 1757 to 1762, he and Pringle became intimate friends, traveling companions, and correspondents. In 1755, Franklin had published in *The Pennsylvania Gazette (15)* Pringle's account of an occurrence of gaol fever. No doubt, during their travels together they discussed Franklin's modern-sounding theory of the contagiousness of colds and catarrhs *(16)*: "I have long been satisfied [apparently since about 1744] from observations, that * * * people often catch cold from one another when shut up together in close rooms, coaches, etc., and when sitting near and conversing so as to breathe in each other's transpiration; the disorder being in a certain state."

FIGURE 2.—James Lind (1716–1794), Surgeon in the Royal Navy (1739–1748); physician to the Royal Naval Hospital at Haslar (1758–1783); founder of naval hygiene in England and promoter of the use of citrus fruits and fresh vegetables to prevent and cure scurvy. He influenced practices of preventive medicine and nutrition among soldiers as well as sailors. (Pen drawing from a portrait by Sir George Chalmers, by A.E.A.H., reproduced *in*: Hudson, A. E. A., and Herbert, A.: James Lind * * *. J. Hist. Med. & Allied Sc. 11: 1–12, January 1956. Courtesy of the National Library of Medicine, photograph negative No. 52–661.)

Franklin was right in his ideas about one mode of transmission of colds and respiratory diseases, but knowing nothing about bacteria and viruses, he assumed incorrectly that the causative agent was "frouzy" air, corrupted, polluted, and rendered putrid by animal substances.

Pringle's observations and recommendations were addressed to officers of the army as well as to physicians. To him, in the 18th century, it was axiomatic, as it is to military authorities today, that the protection of health and maintenance of the health of troops are responsibilities of command, resting primarily upon nonmedical line officers.

Pringle, in his first edition of the "Observations," in 1752, coupled this basic administrative rule with the sage observation and advice *(17)*: " * * * The prevention of diseases cannot consist in the use of medicine or depend upon any thing a soldier shall have in his power to neglect; but upon such orders as shall either appear unreasonable to him, or what he must necessarily obey."

Gerhard van Swieten.—Pringle was a friend and associate of Gerhard van Swieten (1700–1772) who among other accomplishments held the exalted position of physician to the Austrian imperial majesties, the dowager Empress Maria Theresa, and her son, Emperor Joseph II. As army surgeon, van Swieten published in 1758 an important book on the hygiene of troops and diseases incident to armies *(18)*. The English translation published in 1762 was useful to medical men and line officers in the Army of the United States in the Revolutionary War. It was reprinted in Philadelphia in 1776 and in Boston in 1777.

Richard Brocklesby.—Richard Brocklesby (1722–1797) succeeded Sir John Pringle as Surgeon General of the British Army in Germany in 1758, and acquired wide experience during the next 5 years. In 1764, he published *(19)* his "Oeconomical and Medical Observations" in a book which ranks with Pringle's in laying down sound principles of hygiene for armies. Brocklesby insisted upon the good effects of discipline and minute attention to the laws of health as essential to the welfare of an army. He showed that soldiers must have plenty of fresh air in their rooms if they are to remain healthy. He drew up regulations for field hospitals, favoring small regimental hospitals rather than large general hospitals, as did Pringle

and all the great British Army surgeons of the 18th century. In that time, military hospitals were more dangerous to life than battles. These surgeons recognized that infections in hospitals could be reduced by keeping the sick and wounded scattered in small lots. Among the important military surgeons of the American Revolution who were influenced by Brocklesby was James Tilton, whose special design and construction of a small hospital "hut" will be described in connection with some events of the United States Army encampment at Morristown, New Jersey, in 1779 and 1780.

A sequel to Brocklesby's work, and an example of another British treatise on military hygiene which influenced Tilton and others, was Surgeon General Donald Monro's account of the means of preserving the health of soldiers on service, and of disease in the British military hospitals in Germany from 1761 to 1763 *(20)*. While drawing heavily upon Pringle, Monro goes somewhat further in referring in detail to the Mosaic sanitary code, using the same passage from *Deuteronomy* (23: 12–14) that George Washington quoted in his General Order: Of Cleanliness, issued in 1777. (See figure 7, page 34, and appendix A, page 189.) Monroe included a special section about drinking water and "the means of correcting its bad qualities in camps." After mentioning the treatment of water with spirits, wine, vinegar, or cream of tartar, he wrote: "and if the water be previously boiled, it will be so much the better."

INOCULATION AGAINST SMALLPOX (1721); COTTON MATHER AND ZABDIEL BOYLSTON

On 26 June 1721, about a month after the outbreak of an epidemic of smallpox in Boston, Zabdiel Boylston (1680–1766) introduced inoculation, or variolation, into the Colonies *(21)*. On that day, in Boston, he inoculated his son and two of his Negro slaves. After they had recovered from the inoculated variola, he proved by exposing them to cases of smallpox that they were protected

FIGURE 3.—Cotton Mather (1663–1728), theologian and clergyman; interested in the scientific thought, natural philosophy, and medicine of the early 18th century. He stimulated Zabdiel Boylston to immunize against smallpox by inoculation (variolation) in Boston in 1721. This was the first positive achievement in preventive medicine in the Colonies. Mather has been called the first significant figure in American medicine. (Portrait from life by Peter Pelham, 1727, mezzotint. Courtesy of The New York Public Library.)

against the disease. Boylston took this bold action in response to the fervently stated and theologically supported advice of the Reverend Cotton Mather (1663–1728) (fig. 3). Immediately, a violent and prolonged controversy arose. The reasons were numerous — personal, political,

religious, and fear. By many citizens, inoculation was regarded as an impious act contrary to the will of God and as a dangerous source of spread of smallpox. Actually, it was an event of consequence in the history of American civil and military preventive medicine, marking the first deliberate active immunization of human beings against a specific communicable disease. Blake *(22)* has characterized it as "* * * the earliest important experiment in America in preventive medicine," and Beall and Shryock *(23)* have hailed it as "The Advent of Preventive Medicine: Boston, 1721."

The main events of the inoculation period, from 1721 to 1800, are so well known that they need not be recapitulated here. It is, however, pertinent to the theme of this volume to review a few of the occurrences and some of the theories, ideas, and observations of those times which were prophetic of the scientific preventive medicine of the 19th century. Particularly significant were the little-known views of Cotton Mather.

HISTORICAL NOTE ON INOCULATION

Inoculation against smallpox (the insertion into the skin of a normal individual, by scarification or puncture, of material from a fresh lesion of smallpox, with the intention to produce a mild attack of the disease) was an ancient practice of the Chinese and had been utilized in Africa since an uncertain time long past. It came to notice in England about 1700, and in 1714 and 1716, the Royal Society of London published in its "Philosophical Transactions" favorable accounts by Emanuel Timoni, of Constantinople, and Jacobus Pylarini, of Venice. In April 1721, the first inoculation in England was performed on the daughter of Lady Mary Wortly Montagu. Thereafter having been taken up by royalty and found relatively safe and a safeguard, inoculation became widely practiced in England and in Europe. It was applied in the British Army with increasing frequency before the start of the American Revolutionary War.

COTTON MATHER AND "THE ANGEL OF BETHESDA"

Himself a member of the Royal Society since 1713, Cotton Mather was familiar with the published letters of Timoni and Pylarini, and was impressed by them. They confirmed an opinion in favor of inoculation which he had formed "many months" before 1716 on the basis of stories told him by his "Guramantee-servant" (Onesimus), and by other Negro slaves, about the practice of inoculation in Africa. Mather, citing these sources, brought out the African evidence repeatedly in letters and pamphlets and most picturesquely in the manuscript of his never-published volume *(24)* "The Angel of Bethesda."

In "The Angel of Bethesda," Cotton Mather sets forth at some length his theory that smallpox was caused by "animalcula," stating a primitive germ-theory of disease which he derived largely from Benjamin Marten *(25)* and from his knowledge of the works of Athanasius Kircher Leeuwenhoek, and others. He speculated upon the implication of the vermicular, or animalcular, hypothesis of smallpox for immunology *(26)* and chemotherapy, although, of course, he did not use those terms.

Drawing upon the treatise of Bernardino Ramazzini (1633–1714), "De Morbis Artificum Diatriba" (Modena: 1700), he included in "The Angel" a section on occuptional diseases. "Seeing how liable Mariners are to Scurvy," he wrote, "one cannot but encourage them in their Pease-Diet, and the use of Limons * * *." Furthermore, in his section, or discourse, on scurvy he noted that the disease occurred also among people on land: "Parts of America * * * have been of late years greviously infested with a disease called the Scurvy," and for prevention and cure "* * * an excellent thing for the Scurvy * * * is Whey, with the Juice of Orange or Lemon in it. Limons do Wonders, for the Releef of the Scurvy."

STATISTICAL APPROACH

As soon as inoculation had been put into practice, it became a matter of vital importance to compare the risk of death involved in cases of naturally acquired smallpox with the risk of death in inoculated smallpox. Both Cotton Mather and Boylston saw the necessity and significance of the statistical approach to comparative mortality in the two conditions. Therefore, they kept records from which rates could be calculated, thereby providing "one of the first historical instances of the quantitative analysis of a medical problem." Crude at first, this procedure became refined as "the calculus of probabilities," chiefly by French mathematicians. In reporting this event, Shryock has commented upon its importance for preventive medicine, writing as follows *(27)*:

> One of the first to make use of a *statistical comparison in the interest of preventive medicine* [italics added] was the American clergyman, Cotton Mather. He reported to the Royal Society, during the severe Boston epidemic of 1721, that more than one in six of all who took the disease in the natural fashion died; but that out of three hundred inoculated, only about one in sixty died.

Early medical research in America was stimulated by the problems and phenomena of inoculation, as Garrison pointed out in a letter he wrote to Dr. E. C. Streeter on 9 April 1916 *(28)*:

> I have thought much about your plan of a medico-historical Bulletin and hope you and Cushing will put it through. You must look over these treasures in the Boston Medical Library—the unpublished Ms. of O. W. Holmes on Medical History, the medical letters of John Winthrop (Ms.) and the Ms. protocols of inoculation, showing that the colonial physicians in Massachusetts were working on the subject clinically and experimentally.

As "The Angel of Bethesda" was not published, there is no way of telling what influence it might have had upon the development of medicine in America. Various publications, including other writings of Mather, however, indicate that the ideas summarized above had a degree of currency. Some of these ideas became embodied in the doctrines of the military preventive medicine of the

colonial period. As will be shown in more detail later, inoculation against smallpox, introduced by Boylston and Mather in Boston in 1721, and applied to the Continental Army by George Washington in 1777, was an important factor in saving the Army from disintegration and in securing the successful outcome of the Revolutionary War.

THE PRE-REVOLUTIONARY HALF CENTURY

During most of the half century, from 1725 to 1775, battles of the war between England and France were fought in North America. In these campaigns, the American Colonies supplied troop contingents to the British forces. As previously noted, American physicians and men who had become "doctors" through medical apprenticeship, or who had no medical training at all, became familiar with British military medicine and with British ideas and efforts for preserving the health of troops. Some of these Colonials became leaders in the local health activities of their communities, and some later occupied positions of responsibility in the medical organization of the Army of the United States in the Revolutionary War.

PREVALENT DISEASES

Also, during this half century, there were afflictions other than those of war. There was much sickness among the colonists due to endemic and epidemic diseases. The experiences contained lessons for the future Continental Army, but were not heeded sufficiently until several years after the start of the War for Independence. Smallpox appeared in several outbreaks ranging from clinically slight to severe. A severe and fatal one occurred in Charleston, South Carolina, in 1738, and a moderate one in Boston in 1761. The practice of inoculation, employed sporadically—sometimes permitted, sometimes prohibited—came to be supported by Benjamin Franklin, Dr. William Douglass, and other earlier opponents. By the time of the

Revolution, inoculation was practiced on general preventive grounds in the Colonies as it was in England *(29)*.

Throughout the colonial period, there was anxiety over threats of yellow fever and plague, but neither disease appeared in epidemic form *(30)*. A severe and deadly type of diphtheria killed hundreds of children and many adults in a widespread epidemic that lasted through 5 years, 1735-1740, in New England, New York, and New Jersey *(31)*. Measles, long confused with smallpox *(32)*, caused many deaths in New England from 1759 to 1772, was epidemic in Charleston, South Carolina, in 1722 and in Philadelphia in 1778. Scarlet fever occurred from time to time, but may be said to have been not as severe as it was in later epidemics. Intermittent fevers, probably malaria, were becoming widely distributed in the Colonies, occurring as far north as Maine in 1750. The chief causes of sickness and death from communicable diseases were diarrheas, dysenteries, and undoubtedly typhoid fever, which had not yet been differentiated from typhus fever.

PUBLIC HEALTH ACTIVITIES

An outbreak of communicable disease usually aroused the afflicted community to devise new measures for control or strengthen old ones. The major health activities were in control of contagion, chiefly by isolation of the sick and by quarantine of their contacts. In general, a partial list of protective measures applied by colonial communities, periodically and with very variable degrees of effectiveness, includes the following:

1. Sanitation.
   a. Cleanliness: efforts directed toward the control of nuisances of filth and noxious trades.
   b. Disposal of wastes—garbage, excreta, offal, etc.: efforts to prevent or remove bad odors.
   c. Provision of water supplies: efforts to obtain "pure" water and to prevent pollution.
   d. Drainage of swamps, marshes, and stagnant pools: efforts to prevent or eliminate miasmas.

2. Communicable disease control.
   a. Quarantine.
      (1) Isolation of the patient at home.
      (2) Isolation of patients in pesthouses (the lazaretto system).
      (3) Maritime quarantine at ports.
   b. Disinfection of the contaminated environment.
      (1) Explosions of gunpowder; fires in the streets; burning of tar or sulfur in houses.
      (2) Burning of contaminated clothing or bedding.
      (3) Exposure of imported materials to sunlight.
   c. Immunization—inoculation (variolation) for smallpox.

Evaluation of public health activities of the colonial period depends upon whether emphasis is placed upon administration or upon ideas. Emphasizing the former, Smillie *(33)* wrote in 1955:

> In summary, public health administration during the Colonial period was not an important function of government. The community authorities selected temporary health committees in time of serious epidemic. These men acted as consultants, rather than administrators, and served only during the emergency. The enforcement of sanitary regulations, and the maintenance of community cleanliness as well, were not functions of the health officer but were the responsibility of the police authorities of the towns. In time of disaster, voluntary citizen associations did valiant service in caring for the sick poor, and as the cities grew in size, medical, hospital, and nursing care of the poor were provided for, in some degree, by the local government. But for the most part, these services were provided by charitable citizens and were not an official governmental function.

On the other hand, emphasizing the ideological aspects, Tandy *(34)* stated the case as follows:

> Although there had been great developments in the field of medicine during the eighteenth century and a great improvement in popular intelligence to meet this advance in science, sanitary control was still based upon an insufficient body of biologic and medical fact. The etiology of disease was largely unrecognized and the breeding places of disease were undiscovered. The one hundred and fifty years of provincial regulation, however, show constant progress in the field of sanitation. The ideas and machinery which

were developed are suggestive of modern local commissioners and state boards of health. The colonial movement though still embryonic contained the seeds of our present highly developed intelligent direction of sanitary control.

The author of this volume agrees with both assessments and recognizes that the civilian conditions described in these evaluations were the sources of later events. They were among the factors that influenced the evolution of military preventive medicine in the United States Army.

MEDICAL SCHOOLS ESTABLISHED

At the close of the colonial period, two American medical schools were in operation. One was the Medical School of the College of Philadelphia, founded by Dr. John Morgan (fig. 4) in 1765, after his return from 5 years of postgraduate medical study in Europe *(35)*. Later, this school became the School of Medicine of the University of Pennsylvania, which had been founded in 1735. In addition to Morgan, the faculty included Dr. William Shippen, Jr., Dr. Benjamin Rush, and Dr. Adam Kuhn, all of whom became high-ranking officers in the Hospital (the Medical Department) of the Continental Army at various times during the Revolutionary War.

The second institution was the Medical School established in 1768 at King's College (later Columbia University) in New York City. Both schools were closed during the Revolutionary War.

In the preface of his "Discourse Upon the Institution of Medical Schools in America" (p. xiii), Morgan mentions that after the end of his apprenticeship under Dr. John Redman he devoted himself "for four years to a military life, * * * being engaged the whole of that time, in very extensive practice in the [British] Army amongst diseases of every kind." Commissioned a first lieutenant, he served with the Pennsylvania militia in the army of General John Forbes in the campaign against Fort Duquesne in the French and Indian War. Through this he must have had some experience with British military hygiene of

FIGURE 4.—John Morgan (1735–1789), Director General and Physician in Chief of the Medical Department of the Army of the United States (1775–1777). An original proponent of medical education, he was a founder of the first Colonial medical school, in 1765, which became the School of Medicine of the University of Pennsylvania. (Portrait, courtesy of the Armed Forces Institute of Pathology, photograph negative No. WW–396.)

that time, but no details are given. In his prospectus for the new medical school, no provision is made for instruction in either civilian or military hygiene. The author of this volume has found no evidence that the Medical School of the University of Pennsylvania prepared men for work in public health and preventive medicine during the 10 years of its existence from its founding to the start of the Revolutionary War. Undoubtedly, however, Morgan's military experience with a British Army in the field was serviceable to him and to the American forces during the

period from 15 October 1775 to 9 January 1777 when he was Director General of the Medical Department of the Continental Army.

MEDICAL AND SANITARY PERSONNEL

In 1874, Toner *(36)* estimated from a compilation of lists of names, that on the eve of the American Revolution (1775) there were about 3,500 established medical practitioners in the Colonies. Of these, approximately 400 had received formal medical training, about 50 of them holding M.D. degrees from the two American medical schools and about 350 holding degrees, some medical and some nonmedical, from foreign universities and medical schools in London, Edinburgh, Leyden, Paris, and from American colleges. The remainder of medical practitioners had come into the profession through serving apprenticeships under physicians and surgeons, particularly doctors in Boston, New York, Philadelphia, Baltimore, and in Charleston, South Carolina. Among these "medical men," a few had had some experience in civilian sanitation and public health. These were men who had served as health officers, quarantine officers, or as members of community health committees of colonial towns and cities. As previously mentioned, a few had been in contact with British military hygiene during the French and Indian War. The leaders were men of ability, well informed in the medical and hygienic knowledge of the time, as far as it went. In their attempts to prevent and control infectious diseases, all were handicapped by the sheer lack of knowledge, undiscovered, of the causes, or etiology, of these diseases. In addition, deficiencies, incompetence ignorance, poor discipline and low morale were distressingly frequent among most of the men whose services would be needed in the preservation of the health of troops in the event of war.

PART III

The American Revolutionary War and First Years of the Republic (1775-1783; 1799)

ESTABLISHMENT OF THE MEDICAL DEPARTMENT OF THE ARMY

At the beginning of the American Revolutionary War in the battles of Lexington and Concord on 19 April 1775, the Colony of Massachusetts had a relatively strong force of militia, but there was no organized army, no commander in chief, and no military medical department, or "Hospital," as the whole medical service came to be called. These deficiencies were soon remedied. On 14 June 1775, the Second Continental Congress voted to take over the forces assembled in Massachusetts as the Continental Army, and on 15 June appointed General George Washington as Commander-in-Chief. He arrived at Cambridge on 2 July and next day assumed command. Thereafter, one of his first communications to the Congress urged the immediate establishment of "the Hospital," provision for which had been omitted from the congressional military act. He wrote on 20 July:

> I have made inquiry with respect to the Establishment of the Hospital, and find it in a very unsetled Condition. There is no Principal Director, nor any Subordination among the Surgeons; of consequence Disputes and Contentions have arisen and must continue until it is reduced to some System. I could wish that it was immediately taken into consideration as the Lives and Health of both Officers and Soldiers so much depend upon a due regulation of this Department. [Fitzpatrick 3: 350.]

This letter, addressed to the President of the Congress, is symbolic of Washington's constant concern with provision of not only the best possible medical and surgical service for the troops, but also with measures for the preservation of their health. The Congress also had been aware of the need to establish a medical service for the army. On 18 July, 2 days before Washington's letter was written, the Congress appointed a committee to consider the method of establishing a hospital, and on 27 July 1775, voted for "the establishing of an hospital for an army consisting of 20,000 men," defined the staff and its duties, characterized the official positions which included "one Director General and Chief Physician," and specified the allowances of pay *(37)*.

First American *vade mecum* of military hygiene, by John Jones (1775).—"At the commencement of the Revolutionary War," wrote Dr. John Shaw Billings *(38)* in 1876, "we had one medical book by an American author, three reprints, and about twenty pamphlets." The book referred to was a volume published *(39)* by John Jones, in 1775, shortly after the beginning of the Revolution (fig. 5).

Billings disparages the first part of this book which deals with the treatment of wounds and fractures, "as simply a compilation from Ranby, Pott, and others, and contains but one original observation." He does not mention the second part, the appendix on camp and military hospitals and "remarks on the means of preventing diseases in Camp or Garrison," for which, the author (John Jones) wrote, he was indebted to Sir John Pringle's "excellent observations on the diseases of Armies." John Jones had met Pringle in London, probably during his second visit abroad in the late 1760's. This book, by the Professor of Surgery at King's College Medical School in New York City, was the first medical book published in America. It was of great use to the young military surgeons of the Continental Army for whom it was "principally designed."

John Jones had served with colonial troops in a British Army in the French and Indian War from 1758 to 1763. During the Revolution, he served as surgeon's mate and

PLAIN CONCISE

PRACTICAL REMARKS

ON THE TREATMENT OF

WOUNDS AND FRACTURES;

TO WHICH IS ADDED, A SHORT

APPENDIX

ON

CAMP AND MILITARY HOSPITALS;

PRINCIPALLY

Deſigned for the Uſe of young MILITARY SURGEONS,

in NORTH-AMERICA.

By JOHN JONES, M. D.
Profeſſor of Surgery in King's College, New York.

NEW-YORK:
Printed by JOHN HOLT, in Water-Street, near the Coffee-Houſe.

M,DCC,LXXV.

FIGURE 5.—Facsimile of title page of the medical and surgical volume containing an appendix on the hygiene of camps and military hospitals, by John Jones (1729–1791), Professor of Surgery in King's College, New York. It contains a section, mostly derived from Pringle's "Observations," on the means for preserving health in an army. It was of great use to young military and naval surgeons of the Revolution. (Photograph, courtesy of the Library of Congress.)

surgeon of the 10th Massachusetts Regiment of the Continental Line, from 1 September 1777 to 14 May 1781. Following an assignment to Philadelphia in an official capacity in July 1778, after the evacuation of the city by the British, he made his home there for the rest of his life. His frail state of health, due to asthma, limited his field service, but he was able to take an important part in the organization of the Medical Department of the Continental Army.

Van Swieten's manual on diseases incident to armies.—In 1776, 18 years after the appearance of the original German edition *(18)*, two editions of an English translation of Baron van Swieten's "The Diseases Incident to Armies With the Method of Cure" were published in Philadelphia *(40)*. This book was reprinted in Boston in 1777. To van Swieten's booklet were added surgical tracts and an essay on the prevention of scurvy. This publication made available additional information and advice derived from foreign experience in military hygiene. The second printing in 1776 was combined in a single binding with a reprint of John Jones's volume "Plain Concise Practical Remarks." The publication of these two volumes within a few months was indicative of the current interest in military preventive medicine.

In the preface to "Diseases Incident to Armies" (p. 7), van Swieten does not make any excessive claims, but does make a number of wise remarks. He commented:

> It may not be amiss to premise some observations, by means of which, sickness may in some degree be prevented, and the health of the soldier preserved. We are sensible, that in time of war, it is not always possible to observe exactly all what we are going to say; but it cannot but be of use to know what is most advantageous, that it may be put in practice, at least when circumstances permit.

He gave advice, in the preface, under 11 specific "observations." Included among these were advice about diet: "The use of garden stuff and fruit prevents the scurvy, and even cures those already attacked with it"; about clothing, shoes, water, ventilation, selection of dry campsites, personal hygiene, exposure to the heat of the sun,

and about avoidance of crowding: "Great care ought to be taken not to lodge many men in a small space;—and if it cannot be avoided, let the air be at least renewed as often as it can, whether those who lodge together are in health or sickness, for from hence arises the most dangerous, and even the contagious distempers."

Nostalgia, morale, and recreation.—Van Swieten, like Pringle and others, recognized the morale-building and health-aiding values of recreation—games, entertainment, amusements, and exercise. He wrote about this subject as follows:

> First. The soldier fresh lifted, and torn at once from his family, no sooner loses sight of his village, but he becomes melancholy; and tho, a robust husbandman, finds himself scarce able to bear the fatigues and inconveniences of a military life. It were wished, that he could be used, little by little, to this new kind of life; but in the mean time nothing is better, than to procure him all kinds of amusement and diversions.

This kind of depression, or "homesickness," was called "nostalgia," a term first used by Johannes Hofer in 1688 *(41)*.

Frequently during the Revolution, General Washington (fig. 6), other line officers, and military surgeons issued orders or recommendations on the subject of prevention of nostalgia among troops. These statements and subsequent actions forecast the policies and program of the Morale Division of the Adjutant General's Office and the Special Services Division of the Office of the Chief of Staff, in the War Department, in World War II, and their successors, including the Army Recreational Service.

Four great men in the Continental Army during the Revolution—two laymen and two physicians—stand out prominently for their constant striving in promulgating principles of hygiene and their efforts to obtain actions by officers and men to limit the occurrence and spread of disease, and to preserve the health of troops. These men were General George Washington, Maj. Gen. Baron von Steuben, Dr. Benjamin Rush, and Dr. James Tilton. They

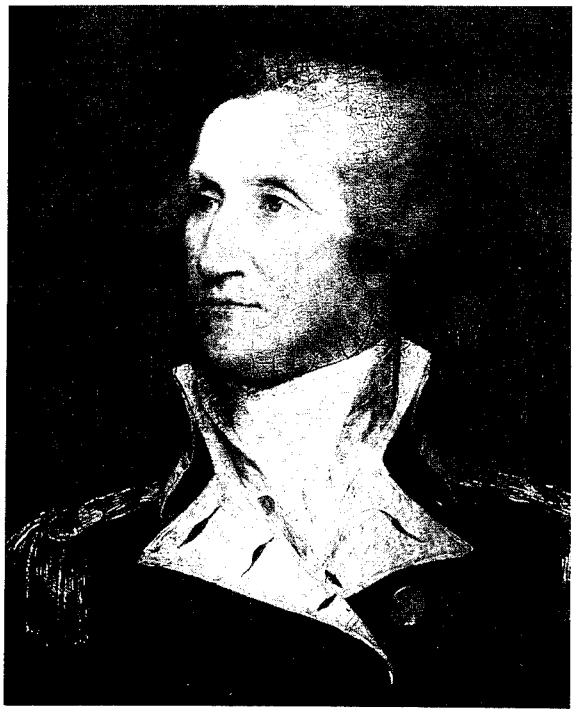

FIGURE 6.—General George Washington (1732–1799), Commander-in-Chief of the Continental Army in the American Revolutionary War (1775–1783); first President of the United States (1789–1797). One of his first official acts as Commander-in-Chief was to urge the Congress to establish the Medical Department of the Army (1775). He was constantly concerned with the preservation of the health of his troops. He issued many sanitary orders and exerted himself personally to enforce measures of preventive medicine. In 1777, he ordered inoculation of the Army to prevent smallpox. (Portrait detail from the painting by John Trumbull (1756–1843): "General George Washington at the Battle of Trenton" (1776). Courtesy of Yale University Art Gallery.)

advanced the evolution of preventive medicine in the United States Army.

George Washington (1732–1799); care for health of troops. — The solicitude of the Commander-in-Chief for the health and welfare of his soldiers and his re-

gard for medical officers and the Medical Department of the Army are documented by innumerable records. In the collected writings of George Washington *(42)*, there are hundreds of references to military health precautions, cleanliness broadly conceived, sanitation, policing of camps, huts and quarters, food (diets, rations, and "the proper dressing" of provisions), clothing, hospitals and The Hospital, inoculation for smallpox, sulfur ointment for inunction for the itch (scabies), and a great variety of hygienic matters—all attesting to Washington's personal interest in doing everything he knew how to do to preserve the health of the troops. "The General has nothing more at heart, than the Health of the Troops," was written at the beginning of general orders issued from Headquarters in New York on 5 August 1776.

One of his first general orders issued at Headquarters, Cambridge, Massachusetts, 4 July 1775, addressed to line officers whom he held responsible for the health of their men, reads:

> All officers are required and expected to pay diligent Attention to keep their Men neat and clean; to visit them often at their quarters, and inculcate upon them the necessity of cleanliness, as essential to their health and service. They are particularly to see, that they have Straw to lay on, if to be had, and to make it known if they are destitute of this article. They are also to take care that Necessarys [latrines] be provided in the camps and frequently filled up to prevent their being offensive and unhealthy. Proper Notice will be taken of such Officers and Men, as distinguish themselves by their attention to these necessary duties. [Fitzpatrick 3: 309–310.]

Mosaic sanitary code: cleanliness.—Throughout the Revolutionary War, general orders of this type were issued repeatedly. Many orders included exhortations, and threats of punishment of officers who did not persevere in the "constant and unremitted Execution thereof," and penalties (including being fired upon) for men who fouled the camp. Washington emphasized strongly the principle of cleanliness, broadly conceived to include both personal hygiene and environmental sanitation. Like Pringle, Brocklesby, Tilton, and others, Washington invoked the

HEAD QUARTERS, PEEKS-KILL.

GENERAL ORDERS

For the ARMY under the Command of Brigadier General M'DOUGALL.

THE Rank and File of each Company will be equally divided among the Serjeants; who are to take a Roll of their Diviſion or Squad, and be anſwerable that the Arms and Clothes of the reſpective Men given to them in Charge, be kept clean and in good Order.

A Copy of the Roll, with the Serjeant's Name, who has Charge of the Men, will be delivered to the Captains, or Commanding Officers of the Companies; and they are to furniſh the Field Officers of their Regiments with another Copy of the Roll of the Company, in the Order they receive it from the Serjeants.

The Troops will be regularly meſſed, Six in each Tent, and the Roll of Duty taken for each Regiment, by beginning with one Man out of each Tent of a Company, then a Second, and a Third, &c. till the Men in each Tent and Company are enrolled in this Order, which will always take them nearly equal out of each Tent, or Meſs for Duty, and leave ſome of their Comrades to take Care of their Clothes, cook their Victuals, and prevent either from being ſtolen, as well as leave ſufficient Room for each Meſs, in every Tent.

The Colonel, or Commanding Officer of each Regiment, will order a Copy of this Roll to be delivered to him; the Men paraded by Meſſes, oppoſite to their Tents, and cauſe the Roll of each Company to be called in his Preſence, that he may be certain of theſe Orders being carried into Execution, which are ſo advancive of the Service, and the Comfort of the Troops. He ſhall anſwer for the Execution of theſe Orders in his Corps; for no Excuſe will be admitted.

INSTRUCTIONS for SOLDIERS in the Service of the UNITED STATES, concerning the Means of preſerving HEALTH.

OF CLEANLINESS.

IT is extremely difficult to perſuade Soldiers that *Cleanlineſs* is abſolutely neceſſary to the Health of an Army. They can hardly believe that in a military State it becomes one of the *Neceſſaries of Life*. They are either too careleſs to pay any Attention to this Subject, or they deceive themſelves by reaſoning from Caſes, that are by no Means ſimilar. Hitherto they have enjoyed a good State of Health, tho' they paid little or no Attention to ſuch Punctilios; hence they conclude, that, tho' in the Army, they ſhall continue to enjoy an equal Degree of Health, under the like Degree of Negligence: Such reaſoning has proved fatal to thouſands. They do not conſider the prodigious Difference there is in the Circumſtances of five or ſix People, who live by themſelves on a Farm, and of thirty or forty thouſand Men, who live together in a Camp. The former chiefly ſubſiſt on vegetable Food; they lodge warm and dry, and they breathe in pure Air, which is not contaminated by noxious Vapours: The latter in general ſubſiſt too much on animal Food; they ſleep frequently on cold and damp Beds, and they breathe in foul Air, that is conſtantly injured by the very Breath of a Multitude; and is frequently rendered much more dangerous by the Stench and Exhalations that ariſe from putrid Bodies. The Air is injured, as I have juſt ſaid by the Breath of a Multitude and the perſpirable Matter that comes through the Pores of the Skin helps to extend the Diſorder. But the Blood and Offals of Cattle that are killed near the Camp, with the different animal Subſtances that are daily thrown there by the Soldiers themſelves, muſt ſoon fill the Air with a peſtilential Smell, unleſs they are immediately removed or covered ſufficiently deep. When the Soldier pours out Water, in which Fleſh has been boiled; when in a peeviſh Mood he throws away Part of his Ration, becauſe it is too much roaſted, or becauſe it is not roaſted enough; or even when he throws away Bones that are not well picked; he ſeldom conſiders that ſuch Things muſt ſoon become putrid, and that he is ſowing the Seeds of Diſeaſe and Death for himſelf or his Companions. The Soldier ſhould burn his Meat rather than throw it away: Hiſtory informs us that great Armies have followed this Rule. Soldiers are not ſuppoſed to be acquainted with the Art of preſerving Health; they are little verſed in Books; but, to the Honour of American Soldiers, it is allowed that no men in Chriſtendom of the ſame Occupation are ſo well acquainted with their Bibles: Let them, once more, read the Hiſtory and Travels of the Children of Iſrael while they continued in the Wilderneſs, under the Conduct of Moſes; and let them conſider at the ſame Time that they are reading the Hiſtory of a great Army, that continued forty Years in their different Camps, under the Guidance and Regulations of the wiſeſt General that ever lived, for he was inſpired. In the Hiſtory of theſe People, the Soldier muſt admire the ſingular Attention that was paid to the Rules of Cleanlineſs. They were obliged to waſh their Hands two or three Times a Day. Foul Garments were counted abominable; every Thing that was polluted or dirty was abſolutely forbidden; and ſuch Perſons as had Sores or Diſeaſes in their Skin were turned out of the Camp*. The utmoſt Pains were taken to keep the Air in Which they breathed, free from Infection. They were commanded, to have *a Place without the Camp, whither they ſhould go*, and *have a Paddle with which they ſhould dig*, ſo that *when they went abroad to eaſe themſelves, they might turn back and cover that which came from them* †.

Beſides theſe general Regulations, it is alſo neceſſary for the Preſervation of Health, that every Soldier be particularly attentive to his own Perſon. The Straw on which he ſleeps ſhould be frequently dried; and he ſhould never ſpread it on damp Ground, when he can get Hurdles, Bark, Boards, Leaves, or any other dry Subſtance to put under it. A Soldier ſhould change his Shirt and Stockings once every two or three Days: Though his Stock of Linen is ſmall, a Shirt is ſoon waſhed. Little Attention is due to the Colour, provided it be clean. Women are never wanting in a Camp for ſuch Offices. A Man is ſeldom aware of the Quantity of noxious Matter that comes through his own Skin and is depoſited on his Shirt; but if he takes up a Shirt that has been worn a few Days by another Perſon, he is frequently offended by the diſagreeable Smell.

Theſe are ſome of the Reaſons why CLEANLINESS of every Kind is neceſſary towards preſerving Health in an Army: They are Reaſons which every Soldier may underſtand; but ſhould he neglect to regulate himſelf accordingly, the Regimental Surgeon will doubtleſs attend to the Neglect, and his Officers will ſee that he does his Duty. For every Soldier by his Neglect not only endangers his own Life, but the Lives of his Companions. Nature, or the God of Nature, has commanded, that men who live in Camps ſhould be cleanly: Whoever proves too obſtinate, or too ſlothful to obey this Command, may expect to be puniſhed with Death, or ſuffer under ſome dangerous Diſeaſe.

W.

* *Numb. 5. 2.* † *Deut. 23. 12, 13.*

Mosaic sanitary code, as stated in the Fourth and Fifth Books of Moses in the King James Version of the Old Testament, *Numbers* 5: 1–4 and *Deuteronomy* 23: 12–14. This is shown in the facsimile reproduction (fig. 7) of the broadside of his general orders for the Army under the command of Brigadier General McDougall, issued at Head Quarters, Peeks-Kill [in October? 1777]. A copy of this broadside *(43)* is reprinted as appendix A, p. 189.

In this broadside, Washington refers to Moses as "the wisest General that ever lived, for he was inspired." He might also, with good reason, have referred to him as "the Founder of Preventive Medicine," as proclaimed by Wood and others *(44)*.

At the end of the horrible winter of 1777–1778 at Valley Forge, Washington made one of his periodic inspections of the camp. According to a note in the Orderly Book of Brig. Gen. George Weedon on 13 March 1778 (as quoted by Middleton *(45)*), Washington found the camp filthy, with carcasses of dead horses and much offal in the streets, and "nastiness, is spread amongst ye Hutts, which will soon be reduc'd to a state of putrefaction and cause a Sickly Camp." Following this, on 13 March 1778, Washington issued general orders from Headquarters, Valley

FIGURE 7.—Facsimile of broadside "Of Cleanliness," general orders issued by Washington at Head Quarters, Peeks-Kill [November 1777?]. Printed by Samuel Loudon, Fisk-kill, 1777. Only two copies of this broadside are known to exist. One is in the Houghton Library of Harvard University, Cambridge, Massachusetts. The other, from which this facsimile was made, is in the New-York Historical Society. The text is more clearly reprinted in appendix A, p. 189. (References: Friedman, Lee M.: Washington and Mosaic Law. *In* Notes and Documents. Miscellanea. Publications of the American Jewish Historical Society 39 (Pt. 3): 318–320, March 1950; Guerra, F.: American Medical Bibliography 1639–1793. New York: Lathrop C. Harper Inc., 1962, No. A–615; and Vail, R. W. G.: A Patriotic Pair of Peripatetic Printers. The Up-State Imprints of John Holt and Samuel Loudon, 1776–1783. *In* Essays Honoring Lawrence G. Worth, Portland, Maine, 1951.) (Photograph, courtesy of the Armed Forces Institute of Pathology, photograph negative No. 66–8139.)

Forge which have a plaintive tone combined with solicitude and sternness: "The Commander-in-Chief: Out of tender regard for ye lives & health of his brave Soldiery, and with surprise that so little attention is paid to his orders, He again in ye most positive terms, orders & commands * * * [clean up the camp and observe the manifold regulations regarding cleanliness]."

Benjamin Rush (1745–1813); preservation of health of soldiers.—Rush (fig. 8), at the beginning of his "Directions For Preserving the Health of Soldiers," published *(46)* first as a newspaper article in 1777 and next year, with revisions and additions, as a pamphlet (fig. 9), by Order of the Board of War, referred to the interest of the Congress in lessening sickness, "and, if possible, preventing it altogether." He wrote: "* * * I maintain that the mortality from sickness in camps is not necessarily connected with a soldier's life. * * *"

Having addressed these "Directions" to the officers of the Army of the United States, he pointed out that responsibility for the health of troops was a responsibility of command:

> * * * the munificence of the Congress, and the skill of Physicians and Surgeons, will avail but little in preventing mortality from sickness among our soldiers, without the concurrence of the officers of the army. Your authority, Gentlemen [line officers], is absolutely necessary to enforce the most salutary plans and precepts for preserving the health of the soldiers.

In the statement quoted above, Rush emphasized a basic principle of operational preventive medicine, which is as sound today as it was then.

Later, in further development of his ideas as to the means of securing command concurrence and effective joint medicomilitary effort, he had the following to say about the relationship of chief medical officers to line commanders. On 26 July 1798, Rush wrote to Dr. James Craik, the newly appointed Physician General of the Army of the United States:

> I admit with General Washington in a late letter [4 July 1798] to Mr. Adams [John Adams, 2d President of the United States]

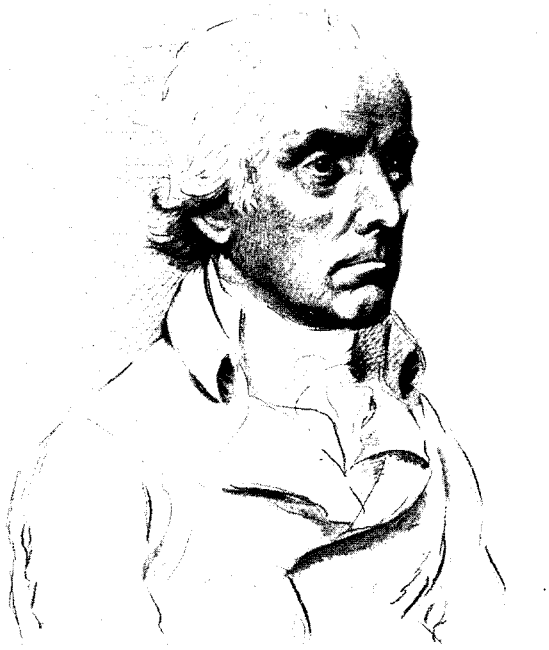

FIGURE 8.—Benjamin Rush (1745–1813), highly influential physician; a signer of the Declaration of Independence; Surgeon General of the Middle Department, Continental Army (1777–1778). He was the author of numerous books and pamphlets, including "Directions for Preserving the Health of Soldiers" (1777 and 1778), facsimile of the title page of which is shown in figure 9. (Photocopy of portrait drawing by William Haines in 1805. Courtesy of the University of Pennsylvania.)

that the physician general of an army "should be one of the limbs of a commander in chief." He should reside in his family. No order for marching, encamping, eating, drinking, or even fighting (as far as it relates to the *time* of a battle) should be issued without his knowledge or concurrence. [Butterfield 2: 800.]

While this is a broad statement in favor of a high staff position for the chief medical officer of the army, it involves the whole series of staff relationships. It specifies both general and particular relationships recognized to be important. But far from being observed constantly in the

DIRECTIONS

FOR PRESERVING

THE HEALTH OF

SOLDIERS:

RECOMMENDED TO

THE CONSIDERATION OF THE

OFFICERS

Of the ARMY of the UNITED STATES.

BY BENJAMIN RUSH, M. D.

PUBLISHED BY ORDER OF THE BOARD OF WAR.

LANCASTER:

PRINTED BY JOHN DUNLAP,
IN QUEEN-STREET.

M,DCC,LXXVIII.

FIGURE 9.—Facsimile of title page of "Directions for Preserving the Health of Soldiers: Recommended to the Consideration of the Officers of the Army of the United States." By Benjamin Rush, M.D. Published by Order of the Board of War. Lancaster: John Dunlap, 1778. This is a revision of the first version which was published in the *Pennsylvania Packet* or *General Advertiser* 6: No. 284, 1777 (Tuesday, April 22d). (Photograph, courtesy of the Library of Congress.)

United States Army through the years, it was neglected or disapproved at various times, some of which were critical. It was a principle never so bitterly fought over as it was in World War II with respect to the relationships of The Surgeon General and the Medical Department of the Army to the War Department and the Army Service Forces *(47)*. Cogent examples can be cited of the "need to know" by preventive medicine officers, and of the contributions they can make to campaigns when they are thoroughly informed of plans and operations, in advance.

Rush's "Directions" are divided into five sections and "a few hints"; * * * "the art of preserving the health of a soldier consists in attention to the following particulars": I. Dress, II. Diet, III. Cleanliness, IV. Encampments, V. Exercise. In specifying what should be done under each heading, he adds only a few new items to the requirements and measures described by Pringle and others, which have been referred to in previous paragraphs in this volume. As a teetotaler, he strongly opposed the drinking of spirituous liquors, "which prevails so generally in our army," and being a miasmatist he inveighed against the rifle shirt which "besides accumulating putrid miasmata, it conceals filth, and prevents a due regard being paid to cleanliness." He urged commanders to take the utmost care to make their men avoid exposure to conditions of wetness and cold which might cause what is now called "cold injury, ground type." As pointed out by Whayne and DeBakey *(48)*, James Thacher also reported on injuries from cold among troops at Valley Forge and in the raid on Staten Island.

The soldier's more than normal attitude of carelessness toward matters affecting his health is brought out by Rush in one of the "hints which appear to be worthy of the attention of the Gentlemen of the Army." He wrote: "Consider thirdly, that the discipline necessary to make an army victorious, requires that the principle of self-preservation should in some measure be suspended in a soldier. If he be taught that it is a crime to have a single thought about his life in the field, he will soon transfer

the same indifference about his life to the camp or to his headquarters."

To adjust a soldier to this paradox was, and is, a duty of both line officers and preventive medicine officers. The procedures for doing this were, and are, educational—a phase of health education.

Rush's "Directions" continued to be used in the military medical service in the War of 1812 and even up to the time of the Civil War. A facsimile of the pamphlet copy, which had been owned by one of the latter surgeons, was published by Major De Forest in 1908 *(49)*.

Benjamin Rush was a member of the Continental Congress, a signer of the Declaration of Independence, a combater of yellow fever, the founder of psychiatry in America, the greatest American physician of his time, an obstinate believer in miasmas and bloodletting * * * teacher, author, acerbic critic yet withal possessor of a talent for friendship. He wrote much and much has been written about him *(50)*.

Dr. Rush entered the Continental Army Medical Service just before the battle of Trenton in December 1776. On 11 April 1777, he became surgeon and later physician of the Middle Department. Following his acrimonious attacks on Dr. William Shippen, Jr., who had been appointed Director General and Physician in Chief of the Army after the dismissal of John Morgan, and following Rush's criticism of Washington in the affair of the Conway Cabal, he resigned from the Army on 30 January 1778; but, from 1778 until the time of his death in 1813, Rush continued to be interested in the Medical Department of the Army of the United States.

In 1789 he published a volume summarizing and discussing the observations he had made upon the diseases which had occurred in the military hospitals and camps during the Revolution *(51)*. This contained 23 brief specific statements, some of which present ideas and suggestions for military preventive medicine. By 1815, this volume had gone into its fourth edition.

Among his observations, Rush noted that southern troops were more sickly than northern and eastern troops, and that native Americans were more sickly than native Europeans who served with the American Army. He attributed this susceptibility partly to the absence of exposure to disease previous to enlistment. His viewpoint was supported by the experience of others, as summarized succinctly by Col. William Smallwood (and quoted by Brown) in a letter to the Council of Safety of Maryland, October 1776 *(52)*: "One good seasoned and well-trained soldier recovered to health, is worth a dozen new recruits * * *."

Most of the basic content of the "Directions" can be found in Pringle's "Observations on Diseases of the Army." Rush was familiar with this book, and had become acquainted with Sir John Pringle in London in 1768 through an introduction by Benjamin Franklin. On 21 April 1810, Rush began to review Pringle's books with the intention of publishing notes upon them. He finished these notes on 8 June and later in 1810 he brought out an American edition of Pringle's classic *(53)*.

Rush was interested in getting this book into the hands of medical officers. On 4 June 1812, he wrote to William Eustis, Secretary of War, referring to the American edition of Pringle and asking:

> * * * whether a copy of this work would not be an useful and important article in the furniture of every medical chest for the army of the United States. I am the more disposed to ask this question from my knowledge of the inability of many of the young surgeons to purchase it, and from my recollection of the sufferings of the soldiers of the American Revolution from the ignorance of their surgeons of the contents of that book. [Butterfield 2: 1140.]

In his reply dated 8 June 1812, Secretary Eustis stated that orders had been issued "to purchase a number of the late Edition of Dr. Pringle sufficient to be distributed to the medical Staff." [Butterfield 2: 1140, fn. 2.]

Baron von Steuben (1730–1794); order and discipline.— A product of the rigorous military school of Frederick the Great (1712–1786) and a veteran of battles of the Seven Years' War (1756–1763), von Steuben (fig. 10) was a

FIGURE 10.—Baron von Steuben (1730–1794), first Inspector General of the Army of the United States (1778–1784). Disciplinarian and drillmaster, he wrote and published, with the approval of the Congress, "Regulations for the Order and Discipline of the Troops of the United States" (1779). These "Regulations" contained many rules for preservation of the health of soldiers. Discipline became an important element of military preventive medicine. (Photocopy of portrait by Charles Willson Peale, painted about 1780, in the possession of the Pennsylvania Academy of Fine Arts, Philadelphia, Pa.)

Prussian officer admirably qualified to train, drill, and discipline the raw soldiers of the Continental Army. In the grade of captain, he had been an aide to Frederick II, King of Prussia. Consequently, he had been a member of the staff of one of the ablest generals of history and a commander who possessed and practiced to an extraor-

dinary degree a regard for the preservation of the health of his troops and for the care of the sick and wounded.

When, in Paris in 1777, St. Germain, then the French Minister of War, and Beaumarchais presented to Benjamin Franklin and Silas Deane von Steuben's suggestion that he offer his services to the Continental Congress, these two American Commissioners agreed he would be a valuable asset to the American Army. They realized, however, that as a mere captain he would have little chance of succeeding in the proposed work. Therefore, they introduced him as a lieutenant general of the Prussian service. It is recorded that Baron von Steuben, a man of imposing presence and engaging manners, ably played his part in the deception. In February 1778, he was received with high honors by the Congress at York Pennsylvania. His offer to serve as a volunteer was accepted and he reported to Washington at Valley Forge on 23 February. Washington at once assigned him to the training of the troops. He was so successful in adapting Prussian military ideas to the American situation that by 5 May 1778 he was made Inspector-General, and Washington obtained for him the rank of major general in the Army of the United States.

During the winter of 1778-1779 at Valley Forge, he produced his "Regulations for the Order and Discipline of the Troops of the United States." These "Regulations," having been approved by His Excellency, General Washington, were adopted by Congress on 29 March 1779, and were published *(54)*.

In its executive resolution, the Congress *ordered* that the regulations "be observed by all troops of the United States, and that all general and other officers cause the same to be executed with all possible exactness." Thereby the total text became an official directive and manual for the whole army. It is significant for the military remedial medicine and military hygiene of the time that these "Regulations," in addition to being a manual of arms and

drill, contained numerous statements about the treatment of sick and wounded, and many stipulations of measures to be observed for the prevention of disease and for the preservation of the health of the troops. The instructions for all grades of officers specify what they "must" do to establish and maintain good sanitary conditions in camps and on marches. In these respects, the "Regulations" transformed the empirical, practical rules of military hygiene of van Swieten, Pringle, Brocklesby, Rush, and others into imperatives for health preservation—requirements by command of Congress.

Von Steuben's chapter XXIII: "Of the Treatment of the Sick" has been quoted often, as has his "Instructions." But little or no attention has been paid by historians or military writers to the many paragraphs and sentences that deal with principles and practices of military hygiene. A few typical examples are as follows:

> Instructions for the Commandant of a Regiment.* * * 'The preservation of the soldiers health should be his first and greatest care; and as that depends in great measure on their cleanliness and manner of living, he must have a watchful eye over the officers of companies, that they pay the necessary attention to their men in those respects.'
>
> The captains also 'must never suffer a man who has any infectious disorder to remain in the company, but send him immediately to the hospital, or other place provided for the reception of such patients, to prevent the spreading of the infection.' All officers and non-commissioned officers must share responsibility for the cleanliness of the men, their tents, and the camp as a whole. Numerous elements of cleanliness are specified.
>
> In laying out a camp, the 'sinks' (latrines) must be located three hundred feet to the front and rear of the two tent lines. 'The quarter-master must be answerable * * * that the sinks are filled up, and new ones dug every four days, and oftener in warm weather.'

Implicitly indicating the policy that the preservation of the health of the troops was a responsibility of command, all of the sanitary orders in the "Regulations" are addressed to line officers. Surgeons are mentioned only in relation to the treatment of sickness.

There is much good sense in these vigorous "Regulations," which were enforced in some measure. Such enforcement of them as was secured greatly improved discipline, for the benefit of both the fighting power and health of the troops. The sanitary requirements were advantageous. It is not a coincidence that from 1779 to the end of the war, the military capability of the Army of the United States increased steadily until it was more than a match for the British Regulars, and that, on the whole, disease became less prevalent and mortality from sickness decreased. While it is true that inoculation for smallpox had a great deal to do with reduction of sickness after 1777, it is apparent also that these "Regulations" contributed both to vigor in arms and robustness in health.

James Tilton (1745–1822); rules for prevention of diseases.—The clearest and most forceful contemporary American treatise on the preservation of health of soldiers during the Revolution is Dr. James Tilton's *(55)* "Economical Observations on Military Hospitals; and the Prevention and Cure of Diseases Incident to an Army." It was based upon his experiences as a physician and surgeon in the Revolutionary Army in campaigns in the field and service in military hospitals during the years 1776 to 1782 (fig. 11). It was composed by an individual of Washingtonian proportions who was a man of great executive ability and an excellent sanitarian.

Tilton's emphasis upon the primary responsibility of command for military hygiene is stated at the beginning of his Part II, pages 27, and 28–29 *passim,* as follows.

> It may seem strange at first view, that I should call upon commanding officers to take care of the health of the men under their command, or that I should expect they would pay any regard to sickness incident to an army. I hope, however, in the sequel to shew that upon them especially depend the health and comfort of the soldiers, and that the medical staff are only to be regarded as adjutants, in the recovery of the sick.
>
> * * * * *
>
> In a young and inexperienced army especially the officers are too apt to consider military duty as the only obligation upon them,

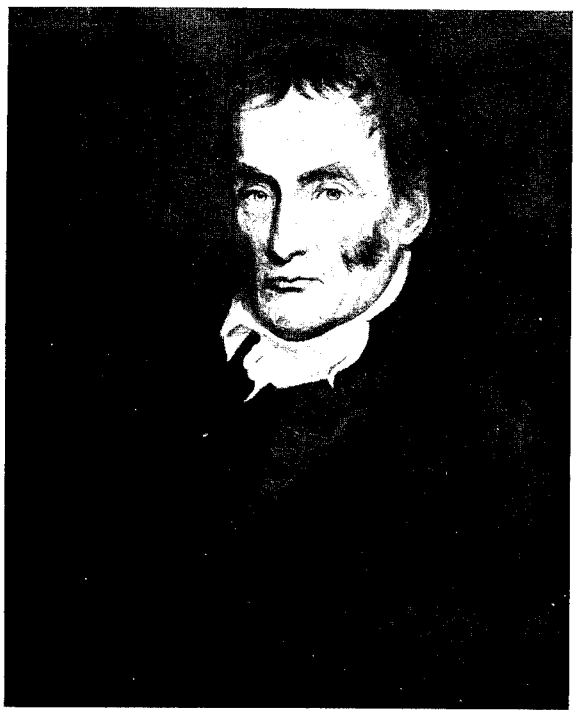

FIGURE 11.—James Tilton (1745–1822), physician and Surgeon General of the United States Army (1813–1815). His "Economical Observations * * *," published in 1813, was largely a treatise on military preventive medicine, based upon his experiences on field service in campaigns from 1776 to 1782. In 1779–1780, he designed and built a hospital planned to "avoid infection." This was an early effort to construct isolation wards and to erect barriers against cross infection. (Photocopy of a composed portrait, courtesy of the Armed Forces Institute of Pathology, photograph negative No. WW–394.)

regardless of the condition of their men, when if they fall sick, are without further thought turned over to the care of the surgeons. The ignorance and irregularities of the men in a new scene of life, subject them to numberless diseases. The sick flow in a regular current to the hospitals; these are crowded so as to produce infection; and mortality ensues too affecting to describe. * * * Send as few as possible to the general hospital.

Ways and means by which military officers have it in their power to prevent and alleviate ordinary sicknesses and distresses of an army are listed and discussed. These matters include:

1. Discipline, which is of the first consequence. "Without it, there can be neither health nor comfort in an army. * * * But more is comprehended under the word discipline than the mere exercise of arms."

2. Avoidance of excessive exposure to heat. "Military exercises ought to be performed in the morning, before the heat of the day, especially in warm weather."

3. Provision of supervised play, amusements, and short marches.

4. Cleanliness—essential. "Officers therefore, should be very solicitous to protect their men, as well as themselves, from the dreadful effects of filth and nastiness." The camp must be kept free from carrion, offal, dead horses, and excrement. Privies may be built over rivers, otherwise dig deep pits [latrines] and cover feces with dirt every day. Tilton calls attention to Brocklesby's quotation of a part of the Mosaic sanitary code as stated in *Deuteronomy* 23: 12–14, which Washington included also in his General Orders: Of Cleanliness, in 1777. (See fig. 7, p. 34, and appendix A, p. 189.)

5. Clothing and accounting of clothing (muster to prevent the men from selling their clothing to purchase liquor) are discussed from the hygienic and other points of view. In this connection, Tilton wrote: "When the Baron Steuben was appointed Inspector General, besides the muster of clothing, he introduced a number of salutary regulations, which contributed more to the health and comfort of the troops, than the utmost efforts of all the medical staff."

6. The immense importance of diet is reviewed. "The ordinary ration is sufficient if well managed." But it is advisable to supplement it with vegetables purchased locally. Soldiers should eat in messes. It is important to associate an old soldier with each mess. "An old soldier would make

good and wholesome food of materials that a young recruit would spoil, in such a manner as hardly to be fit to eat."

7. Hardihood, necessary for efficiency and for withstanding accidents and stress, must be fostered. "A delicate soldier is very ridiculous indeed."

8. For good health and resistance to disease, special care of the skin must be required.

9. The mind of the soldier must be trained. "The influence of the mind upon the body is astonishing." Morale must be built up and maintained by cultivation of the soldier's self-esteem and his sense of honor and reputation.

Tilton's hospital.—Tilton was shocked by the unsanitary conditions that he saw in the military hospitals. He was appalled by the havoc and destruction, loss of life, and depletion of the Army by the sickness and mortality from diseases acquired in the crowded, filthy, stinking tents and buildings used for sheltering patients. In his opinion, "more men of the Army were lost by death and otherwise wasted, at general hospitals [in 1776–1779], than by all other contingencies that had affected the Army, not excepting the weapons of the enemy." As a source of information about proper management of hospitals, he refers to Dr. John Jones "and his useful treatise published at the commencement of the war." (See reference 39.)

Part III, addressed to the medical staff is almost entirely concerned with hospitals. "The cardinal point or principle to be observed in the direction of hospitals," he wrote, "is to avoid infection." Apparently, the word used in this connection meant foul air, or "poisonous atmosphere," miasmas.

After some discussion of the construction of hospitals, Tilton describes the hospital which he "contrived," and utilized with success, at the encampment of the Army at Morristown, New Jersey, in the severe winter of 1779–1780. Laid out "upon the plan of an Indian hut," the one-story structure consisted of a central large section and

two smaller wings on the ends at right angles to the central room. It was constructed of rough logs chinked with clay and had three doors on the south side. The three wards, equipped with bunks or beds, could accommodate a total of 28 patients, 8, 12, and 8, respectively. There were no doors or windows in the walls between the wards. In cold weather, "the fire was built in the midst of the ward, without any chimney, and the smoke circulating about, passed off thro' an opening about 4 inches wide in the ridge of the roof. The common surface of the earth served for the floor. The patients laid with their heads to the wall roundabout, and their feet were all turned to the fire. The smoke contributed to combat infection, without giving the least offense to the patient; for it always rose above their heads, before it spread abroad in the ward."

The ground plan and elevation are shown in figures 12 and 13. From these diagrams, it is evident that the structures provided a small, well-ventilated, uncrowded hospital in which groups of patients could be kept separate. With regard to the feature of isolation, Tilton wrote: "The importance of separating those ill of fevers, fluxes, etc., from the wounded and such as have only slight topical affections, will readily be perceived. Many a fine fellow have I seen brought into the hospital, for slight syphilitic affections and carried out dead of a hospital fever."

Tilton's hospital is especially interesting as an early example of a structure embodying concepts of preventive medicine.

Although much more might be written about those activities of Tilton which had a bearing upon military hygiene, only one type will be mentioned briefly here. These activities were of an administrative nature. From the first, upon his entrance into the Army in 1776, he had been aware of the inadequate organization of the Medical Department. Although, during the next few years, he was little involved in the intrigues, jealousies, and quarrels which caused the bitter undoing of the first chief physi-

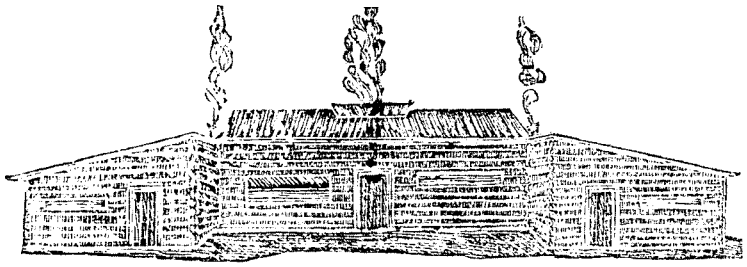

FIGURE 12.—Tilton's hospital at Army Headquarters, Morristown, New Jersey, 1780. Front elevation showing log construction, position of doors, and smoke vents in the ridges of the roof. (Photocopy of a drawing by Tilton in his "Economical Observations * * *," p. 51. Courtesy of the Library of Congress.)

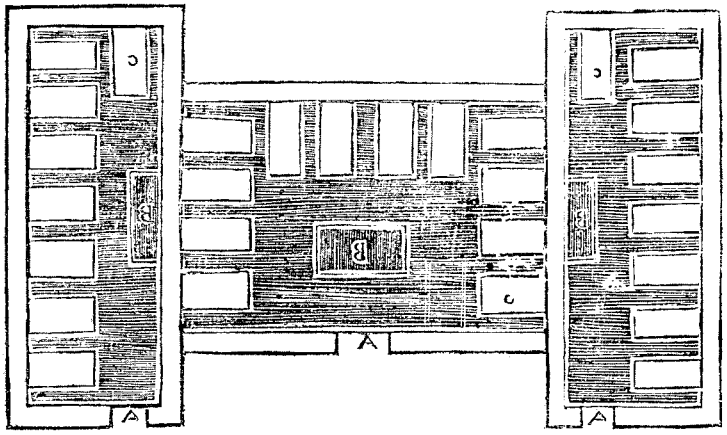

FIGURE 13.—Tilton's hospital, floor plan. A represents the doors, B the fireplaces, C the bunks or bedsteads for patients. The middle, main ward, measured 31½x19½ feet in the clear, and was assigned to febrile patients. The smaller end wards measured 35½x19½ feet. They were occupied by wounded and other cases of "topical affection." (Photocopy from "Economical Observations * * *," p. 52. Courtesy of the Library of Congress.)

cians—Drs. Benjamin Church, John Morgan, and William Shippen, Jr.—he was disturbed by the generally defective arrangements and mismanagement, and saw clearly their deleterious effects upon medicine and surgery, and upon provisions for the care of the health of the troops. He studied the situations at a number of camps and hospitals in 1778 and 1779, and formulated plans for improvements. As a result, he was highly influential in bringing about the passage of the Congressional Act of 1780 which reformed and reorganized the Medical Department of the Army. This activity was prophetic of his future service and career, to which allusion will be made later in this volume.

The Army inoculated against smallpox (1777).—Smallpox was generally prevalent in the Continental Army during the first 2 years (1775–1777) of the Revolutionary War. In 1776, hundreds died of it. The disease was a major factor in the failure of the Quebec campaign, and in the great suffering and mortality among troops which fell back to Crown Point and Ticonderoga in the winter and spring of 1775–1776. In violation of orders, many soldiers inoculated themselves, hoping to prevent an attack of smallpox, but inadvertently spread the disease at the same time. During the summer of 1776, in the Boston area, hundreds were inoculated at the command of military authorities *(56)*.

In April 1776, the intelligent, well-informed Dr. John Morgan, Director General of the Hospitals and Physician in Chief to the American Army, recommended inoculation as universal as possible. His recommendation of the Dimsdale method was addressed not only to practitioners, but also particularly "to surgeons of the hospital, and those in the army under my direction." In doing so, he felt that he was *(57)* "performing one of the most important services a person in my station can well render to them, or to the country and people he is amongst."

The ravages of smallpox in the eastern and northern Armies in 1775–1776 materially reduced the number of

available troops, and the fear of the disease discouraged recruiting. The threat to military operations moved the Commander-in-Chief and the Congress to take bold preventive action. On 6 January 1777, immediately after establishing his headquarters for the first time at Morristown, New Jersey, General Washington wrote to Dr. William Shippen, Jr., who had succeeded Morgan as Director General of the Hospitals and Physician in Chief to the Army, about his decision to attack smallpox, "the greatest enemy of the Continental Army."

To Doctor William Shippen, Junior.

Head Quarters, Morristown, January 6, 1777.

Dear Sir: Finding the small pox to be spreading much and fearing that no precaution can prevent it from running thro' the whole of our Army, I have determined that the Troops shall be inoculated. This Expedient may be attended with some inconveniences and some disadvantages, but yet I trust, in its consequences will have the most happy effects.

Necessity not only authorizes but seems to require the measure, for should the disorder infect the Army, in the natural way, and rage with its usual Virulence, we should have more to dread from it, than the Sword of the Enemy. Under these Circumstances, I have directed Doctr. Bond [Dr. Nathaniel Bond], to prepare immediately for inoculating this Quarter, keeping the matter as secret as possible, and request, that you will without delay inoculate all the Continental Troops that are in Philadelphia and those that shall come in, as fast as they arrive. You will spare no pains to carry them thro' the disorder with the utmost expedition, and to have them cleansed from the infection when recovered, that they may proceed to Camp, with as little injury as possible, to the Country thro' which they pass. If the business is immediately begun and favoured with common success, I would fain hope they will soon be fit for duty, and that in a short space of time we shall have an Army not subject to this, the greatest of all calamities that can befall it, when taken in the natural way.

[Signed by Washington.]

[Fitzpatrick 6: 473, 474. See also reference 45 (2), pp. 131–132, in the cited volume.]

On 18 January 1777, Shippen had these instructions revised to apply to inoculation of all recruits who had not had smallpox. On 10 February 1777 Washington informed the New York Legislature: "The Physicians are now mak-

ing the proper preparations to innoculate all at the several Posts, in this Quarter, and Doctor Shippen will innoculate all the recruits, that have not had the disorder, as fast as they come in to Philadelphia." [Fitzpatrick 7: 129.]

On 12 February 1777, the Continental Congress, sitting in Baltimore, took action somewhat belatedly on the same subject. The Congress ordered that the Medical Committee write to General Washington and "consult him on the propriety of causing such of the troops in his army, as have not had the small-pox, to be inoculated, and recommend that measure to him, if it can be done consistent with public safety, and good of the service."

As General Washington had already instructed that "the troops shall be inoculated," the suggestion of the Congress was taken as a confirmation of the policy. On 23 April 1777, the Congress resolved that Dr. James Tilton be authorized to repair to Dumfries, Virginia, and take charge of the inoculation for smallpox of all Continental soldiers [recruits] coming from the South. Inoculation stations and infirmaries were set up and operated at Dumfries, Alexandria, and Fairfax.

In 1777, compulsory inoculation of recruits became a routine procedure. At that time the mortality from naturally acquired smallpox was about 16 per 100 cases; the mortality from inoculated smallpox was about 1 in 300 cases, 16 percent as compared with 0.33 percent. There was a risk of death in the procedure, but the judgment was to go ahead with it, the authorities believing, justifiably, that the savings far outweighed the possible losses.

Victories of a smallpox-free Army. — The results of inoculation were good. All who have studied this subject seriously (Blake, Duncan, Thursfield, and Hall, whose writings have been cited herein) agree that although after the introduction of inoculation the Army was not entirely free from smallpox, the disease never again caused losses like those suffered from it in the first 2 years of the war. In the writings referred to, there is the recurring type of statement: "After inoculation was introduced in the spring of 1777 Washington had a smallpox-free

army." Inoculation for smallpox contributed substantially to the winning of the war. As Blake wrote *(58)*: "In subsequent years [after 1777], however, most recruits to the American armies were inoculated at the time of induction, and throughout the rest of the War, smallpox, which otherwise might well have proved disastrous, was never a major problem. In this way the medical profession made its most important contribution to the winning of our national independence."

In a general evaluation, without specifically naming the Army, Dr. Benjamin Rush, addressing the students of the Philadelphia Medical School on 20 February 1781, said *(59)*: "Gentlemen, It must afford no small pleasure to a benevolent mind in the midst of a war which daily makes so much havock with the human species, to reflect, that the small-pox which once proved equally fatal to thousands, has been checked in its career, and in a great degree subdued by the practice of Inoculation."

HEALTH OF THE CONTINENTAL ARMY (1775–1781)

Unfortunately, during the preparation of this volume, the author had no opportunity to attempt an original, extensive study of the records of sick and wounded, and of mortality, among Continental troops during the 7 years of hostilities, 1775–1781, of the American Revolutionary War. Applegate *(60)* has rightly pointed out that such a study is greatly needed. If the data exist, they have never been compiled and analyzed. Certainly, complete data do not exist, as, according to Duncan *(61)*: "No complete records of these casualties were kept for so much as one year. Then, too, sickness and mortality varied greatly in different years." Furthermore, as strength figures were not accurately reported, there is no valid base for the calculation of rates. Only partial Revolutionary annals, some estimates, and a few statements are available to serve as material for rough overall approximations, and in a number of instances, for vivid pictures of local situations.

The first general estimate, which has been reiterated during almost a century and a half, was published in 1823 by Dr. James Thacher *(62)* who served in regiments and hospitals from Boston to Yorktown.

Without defining who or what "it" was, Thacher wrote: "It has been estimated, that the loss of lives in the various armies of the United States, during the war, is not less than seventy thousand." He admits that the number who died on prison ships could not be calculated, but states that it is confidently asserted that no less than 11,000 died on board the *Jersey* prison ship. Others, uncounted died at their homes, or by the wayside.

Duncan, using Thacher's figure for total deaths as 70,000, and dividing this by 7 (the years of hostilities from 1775 to 1781, inclusive), estimated a mortality of 10,000 deaths per year from all causes. From various reports, he estimated that 1,000 soldiers were killed in battle or died of wounds each year, making a total of 7,000 battle deaths in all. He concludes: "That ten men died of disease to every one whose life was taken by the enemy is a safe estimate."

With regard to strength figures, Duncan and others enumerate and discuss the many variables involved. While the exact number is not a matter of record, Duncan accepts the estimate of the total number of individuals actually engaged in the military service during the Revolutionary War at 250,000 Regulars and militia combined, as recorded by Heitman *(63)* from governmental reports made in 1787. The average yearly strength is still more a matter of doubt. After considering reports of enlistments, sample strength returns, etc., Duncan decided that it was reasonable to take the figure of 50,000 as the average annual strength of the Army. On this basis, using figures given above, he calculated a death rate of 200 per 1,000 per annum, or 20 percent. With the proportion of 10 dying of disease to 1 fatal battle casualty, the death rate from battle injuries amounted to 20 per 1,000 per annum, and 180 per 1,000 per annum for deaths from disease.

From similar reports from British sources, Duncan calculated that the casualty (mortality) rates for the Continental Army troops were higher than they were among the British and German (Hessian) forces, as shown in the following tabulation.

	Death rates per 1,000 per annum		
	Battle	*Disease*	*Total*
Colonials	20	180	200
British	18	100	118
German (Hessian)	18.75	62.5	81.25

All writers on this subject agree that there was much less sickness and mortality from disease among British troops than there was among American colonial troops. Among the several reasons for this, some are of general significance. The British Army was composed almost entirely of seasoned, regular troops, well-organized and disciplined, fully equipped and well-supplied, and having a relatively more efficient medical department. In contrast, the Continental Army was improvised from inexperienced militia, poorly organized, partially disciplined, often badly fed, frequently poorly clothed and equipped, and with a medical department not well-organized, torn with dissensions, indifferently administered, and inadequately staffed and equipped. The American soldiers came mostly from country districts where they had not had appreciable contact with communicable diseases. They were largely nonimmune and susceptible. Outbreaks of infectious diseases in some bodies of troops into which recruits entered were paradigms of modern experimental epidemiology.

The casualty (mortality) rates from disease among American troops, although not exact, are indicative of actual conditions. There was, indeed, much sickness and death from serious diseases, mainly infectious disease. Typhus fever (called putrid or hospital fever), smallpox (prior to inoculation of the Army), and dysentery (bloody flux) were the most severe. Measles, meningitis, and pneumonia occurred, but not conspicuously. Malaria was common, particularly in the South, but also in the region of

Lake Champlain. Thousands of cases of typhus were contracted in the hospitals.

The most conspicuous differences in the amount of sickness and mortality among the soldiers of the Continental Army are to be found in the critical years 1776, and 1777–1778. Two military operations that were marked by severe disease occurred at Crown Point and Ticonderoga in the summer and fall of 1776, and at Valley Forge in the cruel conditions in the winter of 1777–1778. In June and July 1776, the emaciated, louse-infested (attacked by legions of lice, as one soldier expressed it), half-naked exhausted men, broken in spirit and discipline, crowded into the camps and hospitals at Crown Point and Ticonderoga at the end of the retreat from Quebec and Montreal, closing the disastrous Canada Expedition of 1775–1776. Smallpox, putrid fever (typhus), and dysentery (bloody flux) caused the loss of hundreds of men. Sanitation was almost entirely neglected. Some attempt had been made by the soldiers themselves to limit smallpox by inoculation, but as the practice spread the disease, it was forbidden. At Valley Forge in the winter of 1777–1778, sickness, suffering, and death from communicable diseases intensified the devastating effects of the ferociously cold weather upon soldiers who were short of clothes, shoes, blankets, fuel, and food, and existed in dismal, frigid, filthy huts. Contemporaneous and later writers, notably Middleton *(64)*, have described the harrowing medical aspects of "the Gethsemane of the Revolution." In contrast, the campaign outstanding for healthiness, was the encampment and battle in the region of Saratoga, New York, in the summer and fall of 1777, which resulted in the defeat of British forces and the surrender of Burgoyne on 17 October of that year. The good health of the troops, and especially their freedom from smallpox (attributable to their having been inoculated), were important factors in the winning of the Battle of Saratoga, perhaps the most decisive battle of the Revolutionary War.

SUMMARY AND CONCLUSIONS

The account of sickness and mortality from disease among the troops of the Continental Army during the American Revolutionary War is a gruesome story. There was, indeed, much sickness and a high death rate from diseases. From this, inferences might be drawn that efforts to devise and enforce a program of military hygiene, or what is now called military preventive medicine, either had not been made or were futile. Neither inference is correct. It is true that there was no organized preventive medicine service. However, efforts to prevent disease and to preserve the health of soldiers were centered in the command structure; not in the Medical Department. The combination of preventive activities along a number of lines can be said to have constituted an embryonic program of preventive medicine, although it was not so designated. Nearly all of the modern principles of military preventive medicine, except those which could not be developed before the bacteriological era, were formulated, announced, and sometimes made mandatory by order of the Commander-in-Chief, and even by Congress.

The failures were due largely to ignorance, lack of interest, carelessness, and lack of discipline. The results of the failures are known, approximately, but it is not known how much worse the conditions would have been if no effort had been made to observe these principles. Feeble accomplishments sapped the strength of good ideas, but in instances of good rule-of-thumb sanitation, the benefits were notable.

The preventive principles, which were expounded and observed in various degrees, may be listed in partial and condensed form as follows:

1. Responsiblity of command for the preservation of the health of troops.
2. Use of medical officers as advisers to line officers.
3. Discipline, general and specific.
4. Personal hygiene; cleanliness.
5. Diet and nutrition.

6. Clothing and shoes.

7. Avoidance insofar as possible of exposure to extreme degrees of heat, cold, and fatigue, and to prolonged wetness.

8. Morale-building; recreational activities.

9. Health education.

10. Immunization (active): inoculation for smallpox.

11. Environmental hygiene:

a. Selection of campsites and shelters with regard to factors affecting health; ground water level, drainage, avoidance of marshes, attention to winds and ventilation.

b. Avoidance of crowding; floor space.

c. Sanitation of camps; cleanliness.

d. Disposal of excreta and other wastes.

e. Selection and protection of water supplies; purification of water.

12. Reduction of possible disease-transmitting human contacts; isolation of patients and quarantine.

13. Medical intelligence; rudimentary information about disease-prevalence in areas occupied or to be occupied by troops.

This list of principles has a modern cast. Although one can display the failures and contest the soundness of the basis of the formulations and practices of military hygiene in the Army of the United States in the Revolutionary War, it cannot be denied that military preventive medicine was on the march.

PART IV

From the First to the Second War With England (1783-1812)

DEVELOPMENTS CONNECTED WITH THE MEDICAL DEPARTMENT (1783–1812)

The Legion.—The progress in military preventive medicine, keeping pace perforce with that of the Army of the United States, began to lose headway when Congress halted the forces shortly after the defeat of the British and the surrender of Cornwallis at Yorktown on 19 October 1781. Congress rapidly demobilized the Army during 1782–1784. The Hospital Department was practically disbanded by the time the Revolution was officially closed by the Treaty of Paris, signed on 3 September 1783. During several years, the strength of the total Federal force was under 1,000 officers and men, including a few surgeons and surgeon's mates. In 1790, it was increased to about 2,000, and in 1792, to about 5,000. It was then called a "Legion," and, under the command of Major General Anthony Wayne, was deployed to fight the Indians in various localities. There was a "Surgeon to the Legion," Dr. Richard Allison, who had served as a surgeon's mate during the Revolution. On 13 May 1798, when war with France seemed imminent, Congress authorized an army of 10,000 men, and appointed as Physician General Dr. James Craik, friend and physician of George Washington and formerly physician to the Army of the Revolution. As the threat of war with France evaporated, this force was never completely organized. All but a few officers and men were discharged by 15 June 1800. This disbanded

all the medical officers except 6 surgeons and 12 surgeon's mates. James Craik was mustered out of service on 15 June 1800. No additional military force, or medical organization, was authorized by Congress until 1808 and again in 1812, when a second war with Great Britain appeared inevitable.

Military medical retrogression.—The period of 12 years at the beginning of the 19th century has generally been regarded as one of retrogression in American military medicine. As an example of this appraisal, the following is quoted from *(65)* the "Military Medical Manual":

> 1800–1812. During this interval very little information is available concerning the medical service of the Army. It is known that there was no central organization of the medical staff, and there was no hospital department. Sanitation in the modern sense did not exist. The average soldier was without medicines or medical attendance and recovered from illness by the strength of his own physical resistance or died in misery.

This dismal assessment is partly correct and partly due to ignorance. It can be shown to have been too pessimistic. When the whole period from the Revolution to the War of 1812 is examined, as was done in the preparation of this volume, a number of events of importance to the evolution of military preventive medicine in the United States Army are seen identified. Some of these developments took place in direct relation to the residual or fluctuating Medical Department. Others, which were to be influential in the future, arose in scientific and medical communities outside the Army.

Naturally, drugs and medicinal preparations were used by soldiers as well as by civilians in attempts to preserve health and cure sickness. After the Revolution, patent medicines began to flourish. According to Young *(66)*:

> * * * ingenuity on the part of Americans themselves did not come until after the fighting was over. It was part of the great fire of cultural nationalism, kindled during the war and fanned into higher flame by the pride of victory. The United States gloried in new American textbooks, American maps, American Bibles, American machines. Reputable medicine reflected the trend. There was a renewed search by American physicians to discover American herbs

which could relieve the American sick of "unrepublican dependence" on European medicines. Efforts were begun to compile an American pharmacopoeia.

First American pharmacopoeia (Lititz).—Actually, the first American pharmacopoeia *(67)*, known as the "Lititz Pharmacopoeia," had been compiled by Army medical officers as early as 1778 in the days of Valley Forge. This was a small booklet of 32 pages, with the text in Latin, presenting, as the translated title states, "the simplest and most efficacious drugs and prescriptions for use in the military hospitals belonging to the Army of the United States, especially adapted to our present poverty and straightened circumstances due to the ferocious inhumanity of the enemy, and cruel war unexpectedly brought upon our fatherland." It was based upon the Edinburgh Pharmacopoeia of 1756. Among the prescriptions were three preparations of Peruvian bark for use in the treatment of intermittent fevers; apparently not used for malarial prophylaxis. A prescription for sulfur ointment was provided for the treatment of scabies and the prevention of its spread. The second edition of this small compendium was published in Philadelphia in 1781, with the authorship ascribed for the first time to William Brown, M.D., who was Physician General of the Hospital of the Middle Department and was stationed in Lititz, Lancaster County, Pennsylvania, in 1777–1778. From this start can be traced interests and developments that led to the production of the Massachusetts Medical Society Pharmacopoeia (1807), the New York Hospital Pharmacopoeia by Drs. S. L. Mitchill and Valentine Seaman (1815), and the National Pharmacopoeia, developed through the efforts of Dr. Lyman Spalding (1817–1819).

Until 1896, authorship of the Lititz Pharmacopoeia was attributed to Dr. William Brown. In that year, perversely, an anonymous writer of an undocumented editorial in a medical journal claimed that the actual author was Dr. James Tilton. This aroused a controversy not yet settled *(68)*. In 1937, the considered opinion of the assistant librarian of the Army Medical Library was: "So far as

known Dr. James Tilton is not associated with the edition of this work." Whether Brown or Tilton wrote it, the work stands as an important early contribution by medical officers of the Continental Army.

Prevention of communicable disease a military duty. — Prevention of communicable diseases appears to have been specified for the first time, officially and legally, as a military-medical duty in the "Act to regulate the Medical Establishment" passed by the Congress on 2 March 1799. The pertinent portion of this law is as follows *(69)*:

> Section V. *And be it further enacted,* That it shall be the duty of the physician general, with two or more hospital surgeons, to frame a system of directions relative to the description of patients to be admitted into the hospitals; to the means of promoting cleanliness in the hospitals; to the prevention of idleness, skulking and gambling in the hospitals; *to the prevention of the spread of infectious distempers in the camps and hospitals* [italics added] * * *.

The passage of this enlightened Act of Congress was instigated by a report made to President George Washington on 24 December 1798 by Dr. James McHenry who was Secretary of War from 29 January 1796 to 13 May 1800. He pointed out that in its recent enactment for enlarging and strengthening the Army, Congress had not made provision for the Hospital Department. "The certain consequence of disregarding so essential a measure," he wrote, "in the event of war, and the encampment of an army, will be a train of diseases which must cut off a large portion of our troops." Dr. McHenry had been surgeon of the 5th Pennsylvania Regiment from 10 April 1776 to 16 November 1776 when he was captured by the British at Fort Washington. Soon after his exchange he served as secretary to General Washington during 1778-1780. This ended his medical career but not his intelligent interest in military medicine and hygiene. It appears probable that he supervised the drafting of the above-cited Act of 2 March 1799.

Observations by Benjamin Rush.—Although Dr. Benjamin Rush resigned from the Medical Department of the Army on 30 January 1778, he remained a member of the

Medical Committee of Congress which was concerned with the regulation of the Medical Department. Throughout the remainder of his civilian life, he was in touch with American military medicine and hygiene. He influenced activities in those fields by two notable publications, and by his theories of the nature and causes of epidemic diseases, to which brief reference will be made later in a passage concerned with Noah Webster. The first of these two publications was his observations upon the diseases which occurred in military hospitals and camps during the Revolution. The "Result of Observations" is presented in 28 succinct and cogent paragraphs, abstracts of most of which are as follows *(70)*:

1. The Army, when in tents, was always more sickly than in the open air; more healthy when kept in motion than when it lay in an encampment.

2. Men under 20 years of age were subject to the greatest number of camp diseases.

3. The southern troops were more sickly than the northern and eastern troops.

4. Native Americans were more sickly than European natives serving in the American Army.

5. Men above 30 and 35 years of age were the hardiest soldiers in the army.

6. The southern troops sickened for lack of salt provisions; their strength and spirits were restored by meals of salted meat.

7. Officers who wore flannel shirts next to their skin, in general escaped fevers and disorders of all kinds.

8. The principal diseases in hospitals were typhus fevers (typhus and typhoid). Men admitted with other troubles often suffered or died by the above-mentioned fevers.

9-18. Observations on symptoms, course, and treatment of typhus fever.

19. Causes that concurred to produce and increase typhus fever; such as lack of cleanliness, excessive fatigue, ignorance or negligence of officers in providing suitable accommodations and diet for their men, the general use

of linen instead of woolen clothes in summer, overcrowding of patients in hospitals, the sudden assembling of a great number of persons together of different habits and manners. From Blane "* * * it sometimes happens that a ship with a long established crew shall be very healthy, yet if strangers are introduced among them, who are also healthy, sickness will be mutually produced." This happened in the American Army at Cambridge in 1775. While that Army consisted only of New Englanders, there was scarcely any sickness, but when troops of the eastern, middle, and southern states met at New York and Ticonderoga in 1776 typhus became universal and highly fatal.

20. Dysentery prevailed in the military hospitals in New Jersey in 1777, but the mortality was low. The diarrheas and dysenteries were often long continued.

21. The itch (scabies) can be cured by rubbing with flower of sulfur.

22-23. Discusses amputation for gunshot wounds of joints; and describes loss of hearing from artillery fire.

24. Soldiers billeted in private houses generally escaped hospital fever and recovered soonest from all their diseases.

25-26. Tilton's log hut hospitals were found to be very conducive to the recovery of soldiers from hospital fever.

27. "Soldiers are but little more than adult children. That officer, therefore, will best perform his duty to his men, who obliges them to take the most care of their HEALTH."

28. Hospitals were the "sinks of human life" in the army. "They robbed the United States of more citizens than the sword."

Rush's second publication of particular importance for military preventive medicine after the Revolution was his annotated American edition of Sir John Pringle's "Observations on Diseases of the Army," brought out in 1810.

Edward Cutbush on preserving the health of soldiers and sailors.—In 1808, Benjamin Rush came to the fore again as an authority on matters of military hygiene through the publication by Navy Surgeon Edward Cut-

bush, M.D. (1772-1843) of his volume on the means of preserving the health of soldiers and sailors *(71)*.

As the book is concerned with preventive medicine for both soldiers and sailors, the author dedicated it to "the Honourable Robert Smith and Henry Dearborn, Esquires, Secretaries of the Navy and War Departments of the United States." In connection with his observations on military hygiene for soldiers, Cutbush reprinted in the volume Rush's "Directions for Preserving the Health of Soldiers" (1778), saying that: "As it contains many judicious remarks, which will corroborate what I have endeavored to say on a subject of so much importance to the army and government" he wished particularly to make it available in this manner.

Appointed Surgeon in the United States Navy on 28 May 1799, Cutbush saw extensive service in America, at sea, and abroad on missions to Spain, Italy, and North Africa. Eventually, he became senior surgeon of the Navy, and on the basis of his contributions to nautical medicine he is regarded as *(72)* "the Nestor of the Medical Corps of the Navy."

Cutbush's volume is full of sensible remarks based on experience and reading. It can stand alone without a corroborative prop from Rush. Most of its contents are similar to standard writings already abstracted in this volume. It does, however, present effective statements of both old and new knowledge in refreshed phraseology, and, it contains some new material, of which the following are examples.

Guyton de Morveau and disinfection.—Disinfection of foul air (miasmas) in enclosed spaces is considered at some length, and in the appendix the new portable and permanent disinfecting (or fumigating) apparatus of Guyton de Morveau *(73)*, by which chlorine gas was liberated, is described. This apparatus became known in Philadelphia soon after it was devised in France. Two specimens of the permanent apparatus were received by the American Philosophical Society—one in 1803 presented by Thomas Jefferson, and one in 1805 presented by L. A. Pichon who

appears to have been a French military officer. "L. B. Guyton de Morveau, a prominent French chemist associated with Lavoisier in the reformation of the nomenclature of that science, is credited with originating the general method of disinfection of sickrooms in use through much of the 19th century."

Cutbush stressed the need for concern over the quality of drinking water, attributing some gastrointestinal disorders to the consumption of polluted water and to water containing "animalcules." He advised that water should be tested: "Its purity should be examined by chemical tests, which the surgeons should have in their possession." Evidently, this referred to articles that were later called "chemical kits."

Cutbush devotes a large section to physical standards: "In raising an army attention is necessary to procure men who are free from disease, and capable of undergoing the fatigues inseparable from a military life." Observations are made on the subjects of age, and the preferred sizes of soldiers for various categories.

Jackson's system of military hygiene.—Naturally, as Cutbush had been much abroad, he presents a section "On the Different Theaters of War and the Means of Correcting the Influence of Climate." In this connection, he cites two volumes *(74)* by the veteran military surgeon, Robert Jackson, M.D. (1750-1827), who was in Jamaica and America during the years 1774 to 1782. He served with the troops of Cornwallis in North Carolina and Virginia from 1778 to 1780. Both of Jackson's books, containing remarks on military hygiene, were known in America after the Revolution.

The first, reprinted in Philadelphia in 1795 from a London printing of 1791, contains wise remarks on the system of military hygiene of the times. The treatise on fevers in Jamaica and America includes an appendix: "Containing some hints of the means of preserving the health of soldiers serving in hot climates." Clothing received special consideration. Jackson recommended special clothing, lighter than the regular issue of heavy uniforms: "There

can be no grounds for supposing, that a soldier will not fight as well in dowlas [coarse linen or calico] as in scarlet."

Jackson's "system" deals with many matters of military hygiene and administration. Two items of special importance are rank and education. For effective performance of functions, he urged that those to whom the important charge of superintending health is committed "* * * should be so constituted as to maintain an honourable and respectable rank in the military fabric." If this is not attained, the medical officer "will not be useful to the extent of his intrinsic value. He will then be a name without a reality—blamed for the ravages of evils which his knowledge probably foresees and estimates, but which his limited powers do not permit him to control." Finally, Jackson points out the national importance of establishing a medical school for the education and training of army surgeons in all their duties.

DEVELOPMENTS OUTSIDE THE ARMY (1783–1812)

Several civilian intellectual formulations between the end of the Revolutionary War and the War of 1812 exerted effects upon doctrines and practices of military hygiene in America, which persisted through many years of the future.

The cosmic epidemiology of Noah Webster. — Among these developments was the predominating epidemiology of Noah Webster *(75)* which molded Benjamin Rush's pervading theories of epidemic diseases and influenced orthodox medical thought in generations of physicians. Both Winslow *(76)* and Smillie *(77)*, among others, honor the memory of Noah Webster (fig. 14) as the first American historical epidemiologist but deplore the errors of his theories which for a long time inhibited, or retarded, advances in preventive medicine and public health.

The epidemiological theories of Webster and Rush were developed from the relative potencies ascribed to principles of contagion, miasmas due to organic decomposition, and

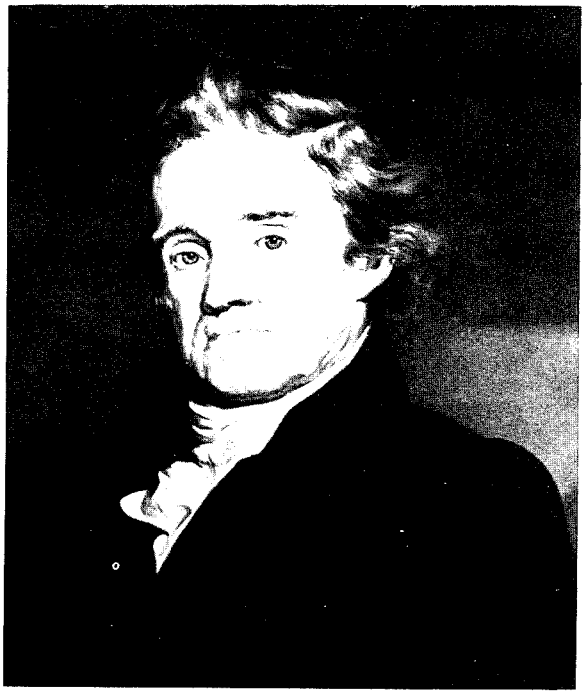

FIGURE 14.—Noah Webster (1758–1843), first American epidemiologist. His theories of epidemic constitution and cosmic epidemiology greatly influenced the thinking of Benjamin Rush and succeeding practitioners of public health and preventive medicine. (Portrait after that by Samuel F. B. Morse. Yale University Art Gallery, gift of the Beaumont Medical Club.)

the epidemic constitution of the atmosphere. Contagion was admitted in measles and smallpox, but in other epidemic diseases such as malaria, yellow fever, and plague, it was either denied a role or given a low rating. Webster, a confirmed disciple of Thomas Sydenham (1624-1689), placed his main stress upon the *genus epidemicus*. He attributed the production of "zymotic" (fermentative) diseases to external stimuli, cosmic objects, conditions, and forces. Derivative dogma specified that zymotic diseases were not transmissible from person to person, and that epidemic diseases were due to natural phenomena which, for

the most part, were unfathomable and uncontrollable. From such hypotheses were developed not only local and global epidemiology but also cosmic epidemiology. Even 50 years later, these views were reiterated influentially in a series of aphorisms by Clot-Bey *(78)* who summarized opinions expressed at the Sanitary Congress held in Paris in 1851. The first aphorism was: "Epidemics are always the result of cosmic conditions."

Anticontagionists: Stubbins Ffirth and others.—A contemporary apparent confirmation of the doctrine of noncontagiousness of epidemic diseases appeared in the remarkable thesis of a student at the University of Pennsylvania Medical School in 1804, Stubbins H. Ffirth (1784–1820) *(79)*. He reported that all of his 15 experiments, in attempts to transmit yellow fever, were negative. Remarkably, he performed all of the tests of transmissibility, except carriage by a mosquito and the periods of infectivity of insect and yellow fever patient, which Walter Reed and his associates carried out in Cuba in 1900. Ffirth slept in the soiled clothing and bedding of yellow fever patients, swallowed their black vomit, dropped black vomit into the conjunctival sack of his eye, and injected black vomit and the blood of yellow fever patients subcutaneously into himself. In no experiment was yellow fever transmitted. Although it is not known with certainty that Ffirth was dealing with cases of yellow fever, the probability is that he was. Whether or not he was immune to yellow fever is not known, although he gave no history of having had the disease.

At the beginning of the 19th century, when the Webster-Rush cosmic epidemiology was taking hold, none of the authorities (brushing aside the earlier suggestions of Mather, Leeuwenhoek, Fracastorius, and others) gave any credence to the possibility that micro-organisms might be able to produce diseases and that parasites might be carried by insects. Apparently, none of the authorities suspected that at least two of the supposititious cosmic influences were so minute as a virus and a mosquito in yellow fever, and so miniscule as a flea and bacterium in

plague. Nevertheless, the ecology, prevalence, and biology of insect vectors of disease and their hosts are admittedly subject to certain cosmic conditions (meteorological, radiological, telluric, etc.). There are still some unknown "Xs" in epidemiology, and the concepts of cosmic epidemiology are not to be cavalierly discarded.

Although the anticontagionists dominated medical thought during the first half of the 19th century, progress in the practical, empirical control of communicable disease in cities and towns, and imitatively in the army, was forced by the devastating power of the great epidemics and by the fears aroused by them.

Medical journalism.—After a detailed, scholarly review of phases of epigraphy, archival collections, and early serial publications (chiefly British and Germanic), Garrison, in 1934, concluded *(80)*: "Thus, the components of medical and scientific journalism as we know it, existed, all of them in the 17th century." This is not to say, however, that there was any useful medical journalism in colonial or Revolutionary America. On the contrary, the first medical journal printed in America appeared in New York only in 1786. This issue was a small volume of translations of selected articles from the first three volumes of the French (Paris) *Journal de médecine militaire (81)*. Although only one number was published, Billings *(82)* and others rate it as a "medical journal." It is of special interest that this first expression of medical journalism in America presented material of value to army surgeons and dealt, in part, with matters of hygiene, sanitation, and preventive medicine relative to preservation of the health of soldiers.

The first indigenous American medical journal *(83)* was *The Medical Repository,* a quarterly established in New York and started on 26 July 1797. It was edited by Samuel L. Mitchill, M.D., Edward Miller, M.D., and Elihu Hubbard Smith, M.D., of Connecticut who was called by Dr. Welch *(84)* "the father of American medical journalism."

This journal gave American physicians a much needed medium for publication of their observations, experiences,

FIGURE 15.—Edward Jenner (1749–1823), discoverer of the method of preventing smallpox by vaccination with cowpox matter (1798). (Photocopy of an engraving of portrait painted by Sir Thomas Lawrence, *from* Pettigrew, T. J.: Medical Portrait Gallery * * * London: Fisher, Son, & Co., 1838, vol. II, memoir No. 10. Courtesy of the Library of Congress.)

theories, commentaries, and criticisms of their fellow practitioners. It furnished also critical reviews of articles and books.

The Medical Repository was discontinued in 1824, after 27 years of good service that opened the way for a vigorous development of medical journalism in the United States. The *New England Journal of Medicine and Surgery,* established in Boston in 1812, has persisted uninterruptedly to this day. The *American Journal of the Medical Sciences,* begun in 1827, superseding the *Philadelphia Journal of*

FIGURE 16.—Benjamin Waterhouse (1754–1846). Having procured cowpox virus matter from Dr. Haygarth of Bath, England, he introduced vaccination against smallpox into the United States in 1800. This method supplanted inoculation, and on 26 May 1812, the War Department, by command of the Secretary of War, ordered vaccination of the troops of the Army; namely, the Peace Establishment and the additional Military Force of 1808. (Photocopy of portrait engraved by R. Reeve. Courtesy of the Armed Forces Institute of Pathology, photograph negative No. WW–2820.)

Medical and Physical Sciences, which had been functioning since 1820, is another old substandard journal with continuous publication.

During the first half century of the Republic, when medical journalism was coming into its own in America, there were hundreds of ephemeral medical magazines, appearing momentarily and disappearing after a few months or years. From the point of view of preventive

medicine and public health, it was not until the last decade of the 19th century and the beginning of the 20th century that the great American journals were established in the fields of hygiene, epidemiology, tropical medicine, bacteriology, virology, immunology, pathology, and statistics, and in numerous other disciplines.

Smallpox vaccination (Jennerian) of the Army (1812).—The period under consideration here may be closed by a salute to one of the greatest achievements in the history of preventive medicine and public health, and to the application of the results of the achievement to the whole United States Army. This event was smallpox vaccination.

In 1798 *(85)*, Edward Jenner (fig. 15) published the account of his discovery that active immunization of man against smallpox could be attained by artificial induction of cowpox. In 1799, Jenner's "Inquiry" came to the attention of Dr. Benjamin Waterhouse *(86)* (fig. 16) in Boston, and in 1800 he introduced the method among civilians in America.

Smallpox vaccination (Jennerian) of the Army was first ordered by the War Department on 26 May 1812, on the eve of the outbreak of the War of 1812. This first great War Department official action in military preventive medicine in the Army of the United States is recorded in the archives of the offices of The Inspector General and The Adjutant General, under the date of 26 May 1812, as follows *(87)*:

From the Index of War Department General Orders:

Vaccination: Orders the immediate, of troops, May 26 1812.

From War Department General Orders:

The Surgeons and Surgeon's Mates of the Peace Establishment and additional Military Force of 1808 at the several Posts and Stations will immediately procure matter and vaccinate the troops.

By Command of the Secretary of War.

Thus was vaccination substituted for inoculation in the Army. It soon became a generally accepted method for the prevention of smallpox among both military and civilian personnel, and on 3 March 1813, Congress passed

an act authorizing the President to take a number of steps to make vaccine matter available to the citizens of the United States. During this period, the brilliant success of Jennerian vaccination inspired the concept of the eradication of communicable diseases.

PART V

Three Wars—The Sanitary Reform Movement (1812-1860)

THE WAR OF 1812
(18 JUNE 1812–21 JANUARY 1815)

When the disputes between the governments of the American Republic and Great Britain resulted in the War of 1812, there was no central organization of the Medical Department of the Peace Establishment of the Army of the United States. For many years, the medical personnel had consisted of a few regimental surgeons and their mates, scattered at isolated posts, with no official medical chief. Dr. James Mann (1759–1832), Hospital Surgeon of the Army, who served from the start of the war until it was technically closed by the Treaty of Ghent on 24 December 1814, and militarily finished by General Andrew Jackson's victory over the British at the Battle of New Orleans on 21 January 1815, bewailed the fact that physicians and surgeons of the Revolutionary Army, with the exception of Dr. Benjamin Rush, had neglected to record and transmit their experiences and observations *(88)*. Uninterested in military medicine, the civilian physicians and surgeons of the day were ignorant of the diseases incident to armies, unfamiliar with the police and hygiene of camps, and inexperienced in the operation of military hospitals. In the flux of war, a medical organization had to be devised; and efforts had to be made, under hard conditions and with scant knowledge, to solve old but unenvisioned problems. These problems in varied forms recurred in the wars of 1812, 1848, 1861, and 1898.

As usual, there was a general neglect of sanitation and much sickness among the troops in the north and in the south. The chief diseases were typhus (called "Lake Fever" along the northern border), diarrhea and dysentery, and pneumonia, especially a form known as "peripneumonia notha." Although no new principles were introduced, some remarkable achievements, significant for preventive medicine, were attained.

On 11 June 1813, the venerable, respected, and forceful Dr. James Tilton was recalled from retirement and appointed Physician and Surgeon General of the United States Army. In February of that year, he had published his informative and forthright book "Economical Observations on Military Hospitals and Cure of Diseases Incident to an Army." The opinions expressed in this treatise were having an influence upon congressional thought about the reorganization of the medical department, resulting in the issuance on 1 May 1813 of "Rules and Regulations for the Army," which defined the duties of the Physician and Surgeon General. The appointment of Tilton to that position is regarded as one of the starting points in the establishment of the definitive Medical Department of the Army. Tilton served in this capacity until 15 June 1815, when he retired permanently to his farm near Wilmington, Delaware.

The Burlington Hospital (1812–1814).—In addition to Dr. James Mann, Dr. Joseph Lovell, later to become the first Surgeon General of the War Department, performed duties superbly during the War of 1812. In the first year of the war, Lovell established at Burlington, Vermont, a hospital which became a model, under the direction of himself and his successors, as chiefs, Drs. Walter W. Wheaton, James Mann, and Henry Hunt. Mann *(89)* included in his "Medical Sketches" details of the regulations which brought the Burlington Hospital to a high state of efficiency, "where," according to Mann, "in no instance from its first establishment, even when the monthly reports counted from six to nine hundred men [distributed in 40 wards], was an infectious disease gener-

ated or propagated." The regulations through which this salutary result was accomplished embodied all of the empirically determined measures that were included in the broad concepts of cleanliness, ventilation, isolation of febrile patients, attention to diet, and the location of the hospital on high grounds, 60 or 70 feet above the nearby water. At Burlington during the first 4 months of 1814, there were 2,412 admissions and 75 deaths. The record made by this model hospital was a demonstration that infectious diseases could be considerably controlled, and lives saved, by application of sanitary measures devised without the benefit of microbiology long before the bacteriological era.

Vaccination.—Finally, it is to be recalled for emphasis, that War Department General Orders, issued on 26 May 1812, required that all troops be vaccinated against smallpox, and that, on 3 March 1813, the Congress passed a law establishing an agency for the provision of Jennerian vaccine matter to citizens of the United States. Bearing on the issuance of this General Order in 1812 and the law passed by Congress in 1813, it is undoubtedly of significance that the two successive Secretaries of War during the period from 1801 to 1817 were well-educated physicians, distinguished Army officers, and statesmen. There was first Dr. Henry Dearborn (1751–1829) who was Secretary of War in the cabinet of President Thomas Jefferson throughout both terms from 1801 to 1809. The second was Dr. William Eustis (1753–1825), Secretary of War from 1809 to 1816, in the cabinet of President James Madison. Both were in position to hear much about Jenner's discovery and the success of his method of vaccination against smallpox and to influence the passage of both the regulation and the legislation.

THE REGIME OF SURGEON GENERAL LOVELL (1818–1836)

On 14 May 1818, an Act passed by Congress reorganized the staff departments of the Army, provided for a Medical

Department, and for *one* Surgeon General. From the passage of this law developed the modern Medical Department of the United States Army. Its general significance was comprehensive. Its special significance for military preventive medicine was determinative, because it established a permanent central military medical organization within which a preventive medicine service could be developed, over the years, with conceptual continuity that persisted through periods of error, administrative failure, financial deprivation, changes in knowledge, and through wars.

Fortunately, a medical officer with vision, talent, and learning was available to occupy the newly created post of Surgeon General. This medical officer was Dr. Joseph Lovell (1788–1836), who was appointed Surgeon General, to date from 18 April 1818 (fig. 17). On 30 June 1817, Dr. Lovell, then Hospital Surgeon of the Northern Division, addressed to Maj. Gen. Jacob Brown a communication entitled *(90):* "Remarks on the Sick Report of the Northern Division for the Year Ending June 30, 1817."

Although this report by Lovell has been referred to often, the citations have been usually in clinical and administrative contexts. It has not been appreciated as a basic document in the history of preventive medicine in the United States Army, although about 90 percent of it deals with military hygiene. Emphasis is placed upon investigations of the causes of diseases and upon preventive measures based upon knowledge, or ideas, of the causes of these diseases. Knowing nothing about microbial causes of infections, Lovell reasoned along the lines of the current concepts of the injurious effects of cold and wet climates, and in words suggestive of the theories of epidemic constitution of the atmosphere, advised taking precautions against unfavorable weather "which no ordinary care can prevent."

Medical police for camp sanitation.—Realizing that surgeons and line officers could not change the weather, Lovell specified ways of safeguarding soldiers by such measures as proper clothing, a liberal supply of dry socks,

FIGURE 17.—Joseph Lovell (1788–1836), Surgeon General of the United States Army (1818–1836). Vigorous supporter of preventive medicine, he instituted medical police for the cleansing and sanitation of camps and hospitals. In 1818, he required Army surgeons to keep meteorological records and to investigate the relation of disease incidence to climate and weather (climatology). These "Meteorological Registers" led to the establishment of the United States Weather Bureau in 1870 through the efforts of a medical officer, Brig. Gen. Albert James Myer (1828–1880), who had created the Signal Corps during the Civil War. In 1836, Lovell founded the Library of the Surgeon General's Office, which became the National Library of Medicine in 1956. In 1819, Lovell initiated a system of reports and publications of vital statistics of the Army, invaluable for the epidemiological basis of preventive medicine. (Photocopy of a painted portrait, courtesy of the Armed Forces Institute of Pathology, photograph negative No. WW–390.)

laced shoes, warm housing, salubrious situations of camps, and finally the institution of "a proper Medical Police" for the cleansing and sanitation of camps and hospitals. He recommended that the surgeon attached to the headquarters of a division be made "Inspector of Hospitals" or Medical Director, in effect, a Chief Sanitary Officer, since "none but the medical staff can be competent" to supervise such matters.

"Meteorological Registers."—Out of these ideas came the War Department's Regulations of the Medical Department, issued in September 1818, which among other requirements ordered surgeons to keep meteorological records, and investigate the relation of disease incidence to climate and weather. As time passed, the annual records were published in four large volumes *(91)* as "Meteorological Registers," one under the direction of Surgeon General Lovell in 1826, and three under the direction of his successor, Surgeon General Thomas Lawson, in 1840, 1851, and 1855. These collections and publications of meteorological data were of value not only to the medical service, including epidemiology and preventive medicine, but also to national and international interests. They led directly to the establishment of the United States Weather Bureau in 1870, through the efforts of a medical officer, Brig. Gen. Albert James Myer (1828–1880), "founder of the Weather Bureau," and, as Chief Signal Officer in the Civil War, "father of the Signal Corps of the Army."

Surgeon General Lovell introduced selection of medical officers on the basis of competence, and elevated the status and efficiency of the Medical Department. He instituted physical standards for the acceptability of recruits. He secured a regulation requiring smallpox vaccination of recruits who had not had smallpox or had not been vaccinated. He encouraged and supported Army Surgeon, Dr. William Beaumont (1785–1853), from 1824 to 1833 in his original investigations of the gastric juice and physiology of digestion in the famous case of Alexis St. Martin.

Library of the Surgeon General's Office.—In 1818, Surgeon General Lovell began to provide medical and scien-

tific books for surgeons at Army posts, retaining at least one copy of each book for his office. This collection grew and formed the nucleus of the great Library of the Surgeon General's Office, which dates its founding as 1836. Among its many functions, it has powerfully supported both civilian and military hygiene and preventive medicine. After passing through other stages designated as The Army Medical Library and The Armed Forces Medical Library, in 1956 this vast collection of books, journals, documents, and manuscripts became the National Library of Medicine, under the administration of the Public Health Service of the U.S. Department of Health, Education, and Welfare *(92)*.

Vital statistics of the Army.—In 1819, Surgeon General Lovell, in collaboration with The Adjutant General, had made provision for the collection of records of the sickness and mortality of troops to all Army posts and stations, according to specific plans. One of the first of Dr. Thomas Lawson's major undertakings after he succeeded Dr. Joseph Lovell as Surgeon General of the Army, in 1836, was to supervise the assembling, collation, and condensation of these data. The first volume prepared under the supervision of Surgeon General Lawson was published in 1840, embracing the 20-year period from 1819 to 1839. This was followed by two more large volumes, one in 1856 and one in 1860 *(93)*.

The pages of these publications are devoted to the investigation of the comparative influence of various systems of climate upon the organization of man. They are "medico-topographical" studies intended to disclose "the laws of nature in regard to external influences upon healthy and diseased conditions of man." The detailed descriptions of posts include the location (latitude and longitude, and geographical), topography, meteorological conditions, case reports, surgeons' reports, and numerical data on morbidity and mortality by diseases. Strength figures are given *(94)*. Many of the narrative vignettes are as vivid as Col. John E. Gordon's "Epidemiologic Case

Reports" from the European Theater of Operations in World War II.

The compilers and supervisors clearly appreciated the general import of these statistical studies and their specific value for preventive medicine. With regard to the latter aspect it is stated in the introduction of the first volume: "* * * Military hygiene—the knowledge of maintaining the health of soldiers, and of promoting their efficiency—is another subject which should not only be carefully studied by medical and all other officers, but receive the special attention of Government."

Climatology.—Combining material from the meteorological registers and the statistical reports on sickness and mortality in the Army, Forry, formerly an Army surgeon who collated and condensed the compilations used in the first statistical volume, produced an original treatise *(95)* on "The Climate of the United States and Its Endemic Influences." In this, he traced out the medical relations of the observed principal physical phenomena of climate. His publication was the first American book on climatology. By numerical (statistical) investigations of diseases, he built firmly one of the piers of modern epidemiology.

THE MEXICAN WAR (1846–1848)

Through the victories gained by Brig. Gen. Zachary Taylor, from Matamoras in April 1846 to Buena Vista in February 1847, and by Maj. Gen. Winfield Scott, from Vera Cruz in March 1847 to Mexico City in September of that year, the United States acquired from the Republic of Mexico a vast addition to its territory. The lands ceded by Mexico in the Treaty of Guadalupe Hidalgo, signed at Mexico City on 2 February 1848, extended from the mouth of the Rio Grande westward across New Mexico to the Pacific Coast as far north as the upper limit of California. The Mexican War, fought with high courage, endurance, and military skill, succeeded in spite of shortages of supplies and equipment, and in spite of much sickness and

mortality from disease, the consequences of lack of knowledge of military hygiene, poor management, and the failure to apply generally such rudiments of sanitation as were known. The military achievement was a brilliant contrast to the dismal sanitary deficiencies.

In describing the main medicomilitary episodes of General Taylor's campaign in northern Mexico, Duncan *(96)*, writing in 1921, cited instances of the prevalence of diarrheas and dysenteries, and commented that: "The care of food and water, disposal of waste, and other functions were carried on in a primitive manner or generally ignored."

In his commentary on General Scott's campaign to the city of Mexico in 1847, Duncan *(97)* assessed the medical activities as follows: "Few encomiums can be passed on the Medical Department in Mexico. Nor do the officers appear to have learned or developed anything of importance in military sanitation, medicine, or surgery. * * * All did honest and faithful work, but none originated anything. They left the service about as they found it. * * * they did as well as they knew."

Duncan drew most of the material for his narrative from Army Surgeon John B. Porter's accounts of his experiences during the whole campaign and a period after July 1848 when the troops returned to East Pascagoula, Mississippi *(98)*. These are largely surgical and medical reports, but do contain a number of descriptions of the filthy conditions in camps and hospitals, the horrors of the widely prevalent chronic dysentery, and a disquisition on the author's conviction that yellow fever was not a contagious disease. On the positive side, however. Porter noted that there was no smallpox among the troops, an exemption which he attributed to vaccination; that General Scott (acting perhaps on the advice of Surgeon General Thomas Lawson who accompanied him in person, as an adviser) moved the troops out of Vera Cruz in time to avoid the yellow fever season; and cited examples showing that the regular regiments had better-policed camps, and were healthier, than the volunteer regiments.

Garrison *(99)*, drawing on both Porter and Duncan, dealt with the Mexican War in a sharp, brief paragraph, from which the first sentence is quoted:

> The Mexican War (1846–1848) is highly instructive to Americans as a campaign of small dimensions, entered upon caravan-wise with boyish, meridional enthusiasm, waged in an unknown country without forethought or adequate preparation, by an army equipped on a peace footing, and carried to a successful issue in spite of untold suffering from lack of clothing, supplies, rolling stock and adequate medical administration.

The reports of The Surgeon General for the years 1846–1849 do not contain anything which contradicts these statements and opinions; indeed, little or nothing is said in them about sanitary conditions. Few details of sickness and mortality are given in The Surgeon General's reports because his office was often out of touch with surgeons in the field in Mexico, and such returns as were received from them were often incomplete and incorrect.

Disease and battle casualty statistics —To fight the War with Mexico, approximately 100,454 North American men were mustered into the United States Army *(100)*. They were in three main categories; namely, (1) Old Establishment; Old Regulars, 15,736, (2) Additional Force; New Regulars, 11,186, and (3) Volunteer Force, 73,532 (regiments and corps, 73,260 and General Staff, 272) making the total 100,454. Of the total Army, 1,549 were killed in battle or died of wounds, and 10,970 died of disease, a ratio of 7 deaths from diseases of the camp (chiefly dysentery) to 1 death caused by battle injury. Duncan *(97)* calculated that the mortality rate for deaths from disease in the Army in Mexico was 110 per 1,000 per annum, which may be compared with rates of 65 and 16 per 1,000 per annum in the Civil War and World War I, respectively. How many thousands were temporarily sick or incapacitated for various periods is unknown. It has been stated in a number of writings that the losses due to disease alone exceeded 33 percent of General Scott's command. The losses by disease in the volunteer corps were nearly twice as high as in the Old Establishment (Regulars).

Civil affairs-military government and public health.—In chapter I, volume VIII, of the preventive medicine history series, it has been pointed out that some of General Winfield Scott's plans, orders, and operations during the final phases of the Mexican War constituted the earliest large-scale venture of the United States into military government and civil affairs, and put into effect principles which became fundamental to American practice in those fields. These activities in Mexico, instituting procedures for trials and punishment for crimes outside those defined in the Articles of War, provided justice and protection for both Americans and Mexicans. They began with General Scott's General Orders No. 20, issued at Tampico on 19 February 1847, declaring martial law. The General-in-Chief reissued the order at Vera Cruz and Puebla, and a final edition of it, General Orders No. 287, "with important additions," at Headquarters, National Palace of Mexico, on 17 September 1847. At first, and for nearly a century thereafter, civil affairs-military government, as it came to be called, was only incidentally concerned with public health activities. In World War II, however, public health activities became such a large and pressing part of the program that the War Department and the Office of The Surgeon General authorized and maintained distinct and strong organizations to carry them out. Taking appropriate action, on the recommendation of Brig. Gen. James S. Simmons, a special Civil Public Health Division was established in 1944 in the Preventive Medicine Service. In addition, the function was represented in all the main theaters of operations. In view of the importance of the subject, an entire volume in this series, Volume VIII, has been devoted to "Civil Affairs-Military Government Public Health Activities," with due acknowledgment of the foresight and wisdom of General Winfield Scott *(101)*.

Rank for medical officers.—At the beginning of the Revolutionary War, surgeons and physicians serving in the Medical Department, or "Hospital" of the Continental Army, had no military rank. Although many attempts

were made to rectify this situation during the succeeding 75 years (approximately), rank for medical officers was not secured until Surgeon General Lawson, constant and vigorous fighter for the improvement and strengthening of the Medical Department of the Army of the United States succeeded, through the War Department, in gaining favorable Congressional action upon the issue, on 11 February 1847. On that date, Congress *(102)* passed an Act (9 Stat. 123) which not only added several surgeons and assistant surgeons to the medical staff of the Regular Army of the United States, but also granted military rank, with appropriate pay and emoluments, to medical officers. This Act of obvious general importance elevated the position of medical officers concerned then, and in the future, with military hygiene, sanitation, and preventive medicine. The Surgeon General himself was advanced to a high grade. On 30 May 1848, Dr. Thomas Lawson was given the rank of brevet brigadier general in recognition of his meritorious service in the Mexican War.

The Act contained a proviso "That the medical officers shall not in virtue of such rank be entitled to command in the line or other staff departments of the army." As medical officers did not wish to exercise such command function, this proviso, while serving as a protection of the anxious and jealous line, was not a hindrance to their work. Medical officers had been placed at last upon a footing of military association with the commanders whom they were to advise, and with the line officers and men whose training in preventive medicine and sanitation they would thereafter be able to directly influence.

THE CRIMEAN WAR
(14 SEPTEMBER 1854–12 JULY 1856)

Losses from disease in British and French troops.—The Crimean War, fought by allied forces composed chiefly of English and French armies against a Russian army, was mainly concentrated in the siege of Sevastopol, from mid-September 1854 to the capture of the city on 9 September

1855. The occupying troops were withdrawn by 12 July 1856. It was a campaign in which courage, valor, and endurance of the soldiers and their leaders triumphed not only over the enemy but also over unpreparedness and poor administration. Immeasurable suffering resulted from shortages of food, clothing, and shelter, and from sickness due to dysentery, cholera, scurvy, and typhus fever. Losses by death from disease were excessive, reaching rates above 200 per 1,000 at times. After citing the "terrible losses" from disease among the British and French troops, Garrison *(103)* pointed out: " * * * the war was an object lesson in the evils resulting from lack of sanitary preparedness and in those resulting from gradual slackening of the eternal vigilance which is necessary to good sanitation * * *."

Garrison based this conclusion upon statistics and statements in Dr. Andrew Smith's official sanitary history of the Crimean War—the first medical and surgical history of a war to be published by a government—and upon statistics compiled and discussed by Chenu, Longmore, and Myrdacz *(104)*.

Beneath this overcast of evils, however, a number of beneficial medical and sanitary achievements made during the Crimean War, or as a result of the war, exerted an influence upon the evolution of military preventive medicine in the United States Army. These positive contributions, rather than a detailed narrative, will be the subjects of this brief section.

Sanitary contrasts.—Sir Thomas Longmore, Surgeon-General of the British Army, writing in 1883, described the remarkable contrast that occurred in the mortality from disease in the British and French armies before Sevastopol in 1854–1855 and 1855–1856. He wrote *(105)*:

> The situation of the French and British armies during the siege of Sebastopol was so similar in respect to soil and locality, the climatic influences to which they were exposed, and the nature of the work in which they were engaged, were so thoroughly alike, that practically the two armies might almost be regarded as parts of one and the same force. * * * there was no similarity between

them in respect to their conditions of health. * * * the British part of the Allied Force before Sebastopol was remarkably unhealthy during the first period of the siege, and as remarkably healthy during the second period of the siege; while a precisely opposite state of things existed in the French part of the force, which was in a generally good condition of health during the first period, but in an extremely unhealthy condition during the second period.

From statistics presented in Longmore's publication, from which deaths from cholera were omitted by the author, the following tabulation shows sanitary contrasts between British and French armies before Sevastopol:

Average effective strength	*Four-monthly periods*	*Deaths from disease*	*Death rates from disease, per 1,000*
British Army:			
31,333	1854, Sept. to Dec.	2,373	.....
	1855, Jan. to Apr.	7,389	235.8
	1855, Sept. to Dec.	463	.....
50,116	1856, Jan. to Apr.	218	4.3
French Army:			
49,150	1854, Sept. to Dec.	1,857	37.7
88,250	1855, Jan. to Apr.	7,666	75.5
137,750	1855, Sept. to Dec.	8,473	61.5
125,250	1856, Jan. to Apr.	17,129	137.0

The explanation advanced for these contrasts is that in the first winter the British troops were inadequately clothed, fed and sheltered, and had poor sanitation, while in the second winter, after the Parliament and the public had become aroused by reports of the scandalous conditions under which British troops were fighting, all aspects of sanitation of the army were vastly improved. In contrast, the French troops which were relatively well clothed, well housed, and well fed during the first winter, suffered from shortages, exposure, and deteriorated sanitation during the second winter. The healthiness of the British soldiers during the second winter—said to be healthier than the Guards in London—showed what could be done for the preservation of the health of soldiers in the field by attention to proper housing, clothing, feeding, and cleanliness, even in ignorance of the microbial causes of disease before the bacteriological era.

Florence Nightingale.—The most versatile, powerful, and steadfast figure of the period of the Crimean War, and afterwards, was Florence Nightingale (fig. 18). Her contributions to medicine and hygiene were surpassingly important. At the Barracks Hospital at Scutari, she created the modern profession of civilian and military nursing *(106)*. But, as Bishop *(107)* has justifiably stated, "Florence Nightingale's ideas and achievements in the fields of public health and hygiene, hospital construction and management, medical statistics, and Indian and colonial health and welfare, have far wider implications than her work for nursing."

Acclaiming Florence Nightingale as a "great pioneer," Winslow *(108)* has emphasized her significance for military hygiene, her vision of the nurse as a "health missioner," her conception and establishment of district nursing coupled with teaching of public health in the home and in the community and region, and finally her conception of the public health nurse, a specially trained agent invaluable to programs of civilian and military hygiene.

The specialty of Army health.—Lewis pointed out *(109)* that: "The appointment of health officers in the [British] Army was one of the many measures which stemmed from the upsurge of public opinion following the revelation of the appalling sanitary conditions suffered by the British soldier in the Crimea."

The Royal Commission of 1857 recommended that medical officers be given powers of advising commanding officers on all matters pertaining to the health of troops, and a provision to this effect became incorporated in British army regulations, representing a type of similar provision in regulations of the United States Army.

The Royal Army Medical School.—As a result of recommendations made by the Royal Commission and by Florence Nightingale, the Royal Army Medical School was established in England, at Fort Pitt, in 1860. Among its educational and training programs, courses in military hygiene were developed, most notably during the professorship of Edmund A. Parkes *(110)*, whose "Manual

FIGURE 18.—Florence Nightingale (1820–1910). At the Barracks Hospital at Scutari in the Crimean War (1854–1856), she created the modern profession of civilian and military nursing, including public health nursing, and made later important contributions to public health and preventive medicine. (Photocopy of portrait drawn by T. Cole, *The Century*, November 1882. Courtesy of the National Library of Medicine, photograph negative No. 5039.2.)

of Practical Hygiene," prepared especially for use in the Medical Service of the Army, went through 19 editions between 1864 and 1900 and was known in the United States as well as in England. It was a standard textbook of the Civil War times. Undoubtedly, the model and experiences of this British military medical school had some influence, as a prototype, upon the planning and establishment of the United States Army Medical School, envisioned by

Surgeon General Hammond in 1862–1863, and established by Surgeon General Sternberg in 1893.

Further influence of sanitary experience of Crimean War.—At the outbreak of the Civil War, the experience of the Crimean War was fresh in the memory of many persons who became concerned in the health and welfare of soldiers of the Union Army. This experience, containing important lessons in military hygiene, exerted a determinative influence upon the establishment and activities of the United States Sanitary Commission, to which this narrative will return later in this volume, in the section dealing with the Civil War.

THE SANITARY REFORM MOVEMENT (1800–1860)

At this point, it is necessary to give almost exclusive attention to the civilian public health affairs of the mid-19th century. To do so may seem a digression. But, on the contrary, this is not a departure from the main subject of this volume because civilian public health envelops military hygiene and influences military preventive medicine in many ways, some direct and many subtle.

The sanitary movement abroad.—"The Great Sanitary Awakening," to use the term employed by Winslow *(111)* and others, took place during the first half of the 19th century. Actually, the awakening in Europe began in 1777–1778 with the work of Johann Peter Frank (1745–1821), "the true founder of modern public health [and preventive medicine] in Europe," according to Smillie *(112)*. It was initiated in England in the last quarter of the 18th century by John Howard (1726–1790) through his reports on conditions in prisons, hospitals, and lazarettos *(113)*.

Chadwick, Farr, Simon, and Smith.—The sanitary reforms in England were carried forward chiefly by four men—three laymen: Edwin Chadwick (1800–1890), William Farr (1807–1883), and Sir John Simon (1816–1904), and one physician: Dr. Southwood Smith (1788–1861). Of these four, the greatest was Chadwick, who, in 1842, pub-

lished his classic "General Report on the Sanitary Conditions of the Labouring Population of Great Britain," and who was influential in securing the passage by Parliament of the Public Health Act of 1848 and the establishment of the first true Board of Health. These events marked the legal birth of sanitary reforms and the beginning of the correction of the horrible, unhealthy, and inhumane conditions of living that had developed under the Industrial Revolution. The English example had a strong effect on the public health movement in the United States *(114)*. The man who was to become the leader of this movement in America, Mr. Lemuel Shattuck (fig. 19), was thoroughly familiar with the writings of Chadwick, Farr, and their associates.

The sanitary movement in the United States; Lemuel Shattuck's Report (1850).—The event which heralded the emergence of sanitary reform and development—"the sanitary era"—in the United States was the publication of the Shattuck Report in April 1850 *(115)*.

This Report is famous as the first concrete and comprehensive plan for an integrated State program of public health in the United States. In his summary and analysis of the Shattuck Report, Smillie *(116)* characterized it as "the cornerstone of the splendid edifice of public health in this nation." It dealt with almost every aspect of public health administration—housing, construction of factories and buildings, ventilation heating water supplies, waste disposal, sewerage, milk and food products, control of nuisances, pollution of the atmosphere, pollution of streams, nursing schools, public health training, control of communicable diseases, and innumerable additional philosophical and administrative aspects of preventive medicine. Although the "Report" was largely opposed and neglected by laymen and physicians for nearly 20 years, Winslow *(117)* has pointed out that "of the fifty recommendations [in the "Report"]— * * * no less than thirty-six are now [in 1948] universally accepted practice—not only in Massachusetts but throughout the Union." In his opinion, only 4 of the 50 recommendations were unimpor-

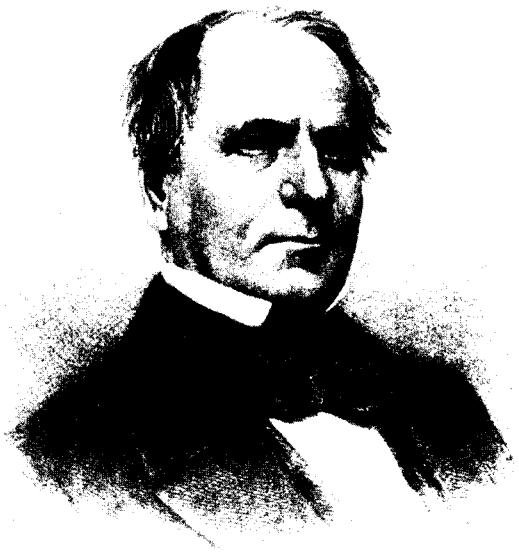

FIGURE 19.—Lemuel Shattuck (1793–1859), pioneer leader of the sanitary reform movement in the United States (1850). (Photocopy of portrait, courtesy of the National Library of Medicine, photograph negative No. 6151–A.)

tant or, in some degree unsound, and the remaining 10 were as sound as the 36 but remained as challenges to the public health profession of 1948.

Considering that Shattuck had no knowledge of the microbial causes in infectious diseases, or of the modes of their transmission, or of human carriers and arthropod vectors of these agents, his "Report" stands out all the more clearly as a masterpiece of careful observation and sound thinking, of intelligent use of statistics, and the formulation of wise conclusions. It was far from "fumbling in the dark," as some writers regard public health activities before the bacteriological era.

Toward the end of the period under consideration, there

was one impressive demonstration of a control measure derived from epidemiological observations and logical reasoning. John Snow (1813–1858), who had stated in 1849 that cholera was waterborne and taken into the body through the mouth, in 1854, stopped an epidemic of cholera in London by removing the handle of the Broad Street Pump.

It is not the intention of the writer of this monograph to elaborate the details of the public health movement of the 19th century. His purpose in these brief notes and comments has been to record the facts that by the middle of that century modern civilian public health and preventive medicine had gained great impetus, and that the ideas, programs, and activities of those days are still influencing present day administration of public health. Although it is not possible to show specifically what, how, and when, measures of the civilian movement became incorporated in the precepts and activities of military hygiene and military preventive medicine, it is nevertheless obvious that such incorporations have occurred. That this should be so is inevitable from the reciprocal relations between civilian and military practices in this field.

PART VI

The American Civil War (15 April 1861-30 June 1865)—Beginnings of Bacteriological Era and Scientific Preventive Medicine (1861-1898)

THE AMERICAN CIVIL WAR (1861–1865)

Sources and critique.—"The Medical Department of today owes more to the Civil War than most of its members realize," wrote Col. Percy M. Ashburn, MC, in 1929 *(118)*. He might well have included, among the unappreciative and disparaging critics, most of the past authors who dealt with the history of that war, and some of the future historians who were destined to write about it.

Weakness of the Army Medical Department at start.—The contributions which Ashburn regarded as especially important were: increased organizational proficiency; the establishment of Letterman's model system of ambulance corps and field hospitals; and improvements in the care of the sick and wounded. He found little to praise in the Medical Department's performance in sanitation and military hygiene, at least during the first year of the war, when the Department was not only small, weak, and unorganized, but was a fossilized relic of the Mexican War in the hands of old, reactionary, unprogressive, rigid, superannuated officers. He attributed much of the inefficiency to lack of knowledge—"not much progress had been made in the prevention of disease, which is fully explained by the fact that bacteriology and its twin, modern hygiene, were yet unborn." Re-echoing this theme, General Sim-

mons allotted only 16 lines to the Civil War in his draft of an introduction. He mentioned a few positive gains: "The Civil War of 1861 was also fought before the advent of preventive medicine [meaning the coming of the "bacteriological era,"] and as usual the disease casualties were enormous, both in the Union and Confederate Forces."

There was indeed much sickness in the Union Army, especially in the first year of the war, when the forces were being increased from about 15,000 regulars to nearly 500,000 men by induction of unseasoned volunteers. But the records of succeeding years, though incomplete, show contrasting periods of relatively good health and a gradual improvement during the last 2 years, partly as a result of seasoning of the troops and partly as a result of improvements in all phases of military activity, including sanitation and hygiene. There were no severe epidemics and no serious hindrance of military operations by communicable diseases. On the whole, conditions of health were considerably better than they were in the Mexican War and among British troops in the first year of the Crimean War.

In the preparation of this monograph, the author has studied many documents, reports, and publications, of which the more important are cited *(119)*. Selecting certain topics, he will not rehearse the oft-repeated narrative of the northern armies in the Civil War, but will deal particularly with certain events which influenced the evolution of preventive medicine in the United States Army—matters of primary concern for this volume. As will become evident, some of the specifically important events arose within the reorganized Medical Department. Others of even greater significance had their origins within the medical services of the field armies, or through the influential activity of a civilian organization—the United States Sanitary Commission.

Morbidity and mortality rates from disease and battle.—The following quotation from pages 27–28 of Duncan's Seaman Prize Essay *(120)* is a fair and brief summary of the statistics of morbidity and mortality:

During this war [American Civil War], lasting from April 15, 1861, to June 30, 1865, the average strength of the Union armies was 806,755 officers and men. The total number of deaths was 359,528 (Fox); 67,058 were killed in battle and 43,012 died of wounds; giving a total of 110,070 deaths from battle casualties; equivalent to a rate of 33 per 1,000 per annum. The number dying of disease is estimated at 224,586, or 65 per 1,000 per annum. These numbers are from the latest revised statistics and are all larger than those given in the M.[edical] and S.[urgical] History of the War. The death rate from sickness, while it appears high, was actually very creditable as compared with the rates of previous wars, usually waged by regular troops. While there was a great deal of sickness much of it was of a mild nature. Of 6,000,000 cases [the total enlistments and reenlistments is estimated to have been approximately 2,800,000], but 200,000 died, or 3.4 per cent. The death rate in the regular troops was 32; in the white volunteers 55; and in the negro troops 133 per 1,000 yearly. Of the wounded 14.6 per cent died, which was the average rate at that time. About two-thirds as many men died of wounds as were killed in battle. Twice as many men died of disease as from battle wounds.

In addition to the deaths named there were 24,877 from accidents, injuries and unknown causes. More than 250,000 were discharged for disability and 200,000 deserted.

Diseases in the Union Army.—Although the catalogue of the diseases that occurred among the Union troops is a long list, only a few groups of them will be mentioned here, and these are selected because of their actual or potential importance, and because the occurrence of some of them (diarrheas and dysenteries, and respiratory diseases) in the armies of the Civil War were prophetic of their recurrence in the Spanish-American War, World War I, and World War II.

Acute and chronic diarrhea and dysentery (121) "occurred with more frequency and produced more sickness and mortality than any other form of disease." In the period covered by the statistics, 1 May 1861 to 30 June 1865, there were 1,739,135 reported cases of diarrhea and dysentery and 44,558 deaths. Occasionally, there were also outbreaks of typhoid fever.

The control measures employed were the usual ones of cleanliness, disposal of wastes and excreta, policing of

camps, and some attempts to purify water or to secure clean sources.

Smallpox was present to a considerable extent in the United States during the war, but at no time could it be considered a prevalent disease among white troops serving in any of the armies or departments. A total of 12,236 cases with 4,717 deaths were reported. There were no serious outbreaks of smallpox, but at times, as in the period from January to April 1864, sporadic cases occurred in all commands. Isolation and vaccination were recognized as efficient means of protection, but often the troops were not satisfactorily vaccinated. Many of the volunteers had never been vaccinated before induction into the army *(122)*.

Malaria, prevalent in the Atlantic and southern coastal regions, was not especially serious. The usual empirical methods of attempted prevention of the "miasmatic" group of diseases subsumed under the term "malaria" were employed routinely; namely, avoidance of the vicinity of swamps and marshes as campsites; avoidance of exposure to noxious airs of night, when feasible; avoidance of chilling and great fatigue, when not in battle, etc., etc.

In addition, quinine sulphate, when available, was used as a prophylactic against malaria. The drug was customarily given by mouth in alcoholic solution—3 grains in a gill of whiskey per day to each soldier in a malarious region —an alcoholic bitters that became the soldiers' favorite medicine and one that they did not spit out. The practice was based on both British and American experiences.

In both the Union and Confederate medical services, a number of authorities were aware of the prophylactic use of quinine by English seamen stationed in tropical regions, especially off the malarious coast of West Africa even as early as 1749, and they were convinced of its value. The administration of quinine to prevent malaria was recommended by the United States Sanitary Commission in July, 1861, and, Van Buren, in his monograph on the subject recorded that he had employed the method with good

results among troops in Florida in 1840. Surgeon General Hammond reported that he had frequently used it with success, especially throughout the unhealthy season of 1862. The deliberate introduction of chemoprophylaxis against malaria, by oral administration of quinine sulphate, marked the development of a new principle in military preventive medicine in the United States Army. This deserves special notice as one of the most valuable lessons from the Civil War *(123)*.

Diseases of the respiratory organs (acute catarrh, bronchitis, and pneumonia, both primary lobar and bronchopneumonia secondary to measles, etc.) were important causes of ineffectiveness and mortality among the soldiers. As usual for armies in the field, fighting during fall, winter, and early spring, many thousands of cases of respiratory disease occurred, especially during the first years of the war *(124)*.

Measles caused 67,763 cases and 4,246 deaths in white troops. Most of the mortality was due to secondary pulmonary infections, chiefly pneumonia. In camps, there were recurrent waves of measles, involving the susceptible persons through successive additions to the strength of the command *(125)*.

There was little or no *yellow fever* among the troops, a result attributed to active measures of sanitation and the strict quarantine regulations imposed by military government at all of the main ports in the South *(126)*.

Among the "camp diseases," outbreaks of jaundice, apparently infectious hepatitis, were numerous, incapacitating, but not highly fatal. Among the white troops there were no fewer than 71,691 cases of probable infectious hepatitis *(127)*.

Venereal diseases, chiefly syphilis and gonorrhea, were more frequent at the beginning and close of the war than in the intermediate period. The control measures applied were mainly reporting of contacts of infected soldiers, treatment of diseased prostitutes, and licensing of prostitutes. It was the opinion of authorities that reduction of

venereal diseases took place under these regulations, at least in Nashville in 1863 *(128)*.

The United States Sanitary Commission.—Immediately after the outbreak of the Civil War the inadequacies of the small and unprogressive Medical Department of the Army were shown up by catastrophies of sanitation, shortages of medical and sanitary supplies, and lack of provision for preservation of the health of the soldiers—both regulars and the new volunteers pouring into the Army of the Potomac and other commands. Responsible civilian citizens, aroused by the reports of these conditions, secured the approval by President Lincoln of an order of the Secretary of War, on 9 June 1861, appointing the United States Sanitary Commission, modeled somewhat after the British Sanitary Commission of the Crimean War. At first the President gave the Commission only limited powers of inspection and advice on medical, surgical, and sanitary matters in camps and hospitals, and in connection with certain nonmedical military activities in the Army. The Commission was authorized to communicate directly with The Surgeon General, medical officers, commanders of troops, the Secretary of War, and even the President. It was not long, however, before the Commission found that it could not get results without more power. Increased authority was granted, and the Commission became a pseudomilitary operating agency. Among its ideals and policies was the establishment and conduct of a "preventive service" in and for the Army *(129)*. When the Commission became operative, it functioned in much the same manner as did the Preventive Medicine Service in the Office of The Surgeon General in World War II, although during the Civil War there was no such specialized division, nor, indeed, any specialized organization in the Surgeon General's Office. He seems to have looked after all the business of his office personally, with little delegation to others.

This civilian commission, operating in the midst of military formations, came into conflict with the military and other officials of the government. Some of the conflicts

were over jurisdictional matters; others were conflicts of personalities. On the whole, however, as Surgeon General Hammond noted in 1864, good relations existed between medical officers and the Sanitary Commission and its agents, and service of inestimable value was rendered by the Commission.

Among other activities, these services were concerned with the hundreds of details involved in the preservation of the health of soldiers, and in provisions for their care, their welfare, and their comfort. From the point of view of preventive medicine the most important division in the Commission's organization was its Camp Inspection Service. Throughout the war, the Commission recognized that prevention was far more effective than relief.

Reorganization of the Medical Department.—The Sanitary Commission soon recognized that the Medical Department of the Army had to be thoroughly reorganized and vitalized. By April 1862, it had assisted in securing the passage of an Act of Congress reorganizing the Medical Department, and after the retirement of Surgeon General Alexander Clement Finley on 14 April 1862 it had stepped in and dictated the appointment of Surgeon, 1st Lt. William Alexander Hammond (q.v.) as Surgeon General, on 25 April 1862, to the disgruntlement of the old regime. Also through the Commission's influence, Surgeon Jonathan Letterman was appointed by General McClellan as medical director of the Army of the Potomac. Both Hammond and Letterman were men of superior ability and the appointments had the direct result of immediate improvement and future development of preventive medicine in the army.

Publications by the Commission and health education.—During the war, distinguished American physicians and surgeons, members of the Sanitary Commission, prepared monographs, or military medical and surgical essays; and these were published by the Commission and issued to medical and line officers. They were received with favor; there was an immense demand for them. Among these monographs, a number were of special interest as docu-

ments of and involving preventive medicine. These subjects included: (1) Military Hygiene and Therapeutics, (2) Control and Prevention of Infectious Diseases, (3) Quinine as a Prophylactic against Malarious Diseases, (4) Scurvy, (5) Rules for Preserving the Health of Soldiers, and (6) pamphlets on various communicable diseases, including venereal diseases. In July 1864, Surgeon General Hammond, in view of "The favor with which they have been received both at home and abroad, and the wish expressed in many quarters that they might be arranged in a more permanent form," collected and published 17 of these essays in a single volume *(130)*.

"These pamphlets are a historical landmark, for they initiated a special technique of health education which, in later years, developed into enormous proportions and became one of the standard procedures of health education in America." In making this evaluation, Smillie *(131)* was thinking particularly about civilian public health. From military experience, however, it can be said that the procedure is equally valuable in the practice of preventive medicine in the army.

Surgeon General Hammond starts a new era.—Surgeon William Alexander Hammond (1828–1900) (fig. 20), 34 years old, was moved up from the grade of first lieutenant to the rank of brevet brigadier general in one lift and appointed Surgeon General of the United States Army on 25 April 1862, thanks to the powerful influence of the United States Sanitary Commission, which recognized that he had talents even surpassing the mass and vigor of his physique. He was a man of prodigious energy, vision, originality, force, courage, productivity, learning, and literary skill. From studies, reading, and experience, he was extraordinarily well informed. Intensely interested in all phases of the medical service and the activities of the army, he lost no time in starting needed reforms and new undertakings. His entrance upon the stage marked the beginning of a new era in the history of the Medical Department. He gave to developments an impetus which carried

FIGURE 20.—William Alexander Hammond (1828–1900), Surgeon General of the United States Army (1862–1864), and a strong proponent of civilian public health and military preventive medicine. Founder of the Army Medical Museum and sponsor of the "Medical and Surgical History of the War of the Rebellion," he proposed the establishment of an Army medical school and an Army general hospital. (Portrait photograph, courtesy of the Armed Forces Institute of Pathology, photograph negative No. 61–4774.)

into advances, even though they were checked unfortunately by his personal feud with Secretary of War Stanton toward the end of the Civil War *(132)*.

Surgeon General Hammond was fortunate in having several intelligent, able, pragmatic idealists as associates. Among those especially to be mentioned were Surgeon Jonathan Letterman, Medical Director of the Army of the Potomac, deviser of the system of field hospitals, originator of the new Ambulance Corps, and reorganizer of the

whole field of medical service; Surgeon John Shaw Billings, also a medical inspector under General Grant during the Wilderness Campaign, later to become the chief public health authority in the Army Medical Service and builder of the Surgeon General's Library, greatest medical bibliographer; and Surgeon Joseph Janvier Woodward, chief compiler and author of the great "Medical and Surgical History of the War of the Rebellion," one of the first to be concerned in the buildup of the Army Medical Museum, pioneer microscopist and pathologist, originator of Army medical laboratories, and forerunner of Sternberg. In many ways, these men contributed importantly to the evolution of preventive medicine in the United States Army.

Hammond and Letterman; improvements and innovations.—Shortly before Hammond was appointed Surgeon General, Congress, influenced considerably by depositions made by the United States Sanitary Commission, and recommendations made by Surgeon General Finley, as mentioned previously, passed the Act of 16 April 1862, which reorganized the Medical Department of the Army *(133)*.

Among the numerous specifications in this Act, two sets of regulations were particularly important for the advancement of military hygiene in the Army. These were substantially as follows:

1. Increased rank (to general officer grade) for The Surgeon General; enlargement of the staff of the Medical Department; and a strengthened administrative position for the Medical Department through which authority was wielded, orderliness of procedure acquired, and confusion reduced methodically.

2. Eight (later increased to 16) Medical Inspectors were authorized, and subsequently appointed. These officers were charged with the duty of carrying out in the name of The Surgeon General supervision over every sanitary matter that affected the health of the troops. [These were the forerunners of sanitary inspectors in the Army in the 20th century.] Renewed and expanded requirements for monthly sanitary reports were specified.

It must be admitted that most of the Medical Inspectors became concerned chiefly with conditions in hospitals and with the care of the sick and wounded. Nevertheless, a principle was established, and emphasis upon the management of sanitation was increased. The Medical Inspectors, and all medical officers, were charged with responsibilities for making inspections and for furnishing advice and recommendations on sanitary matters. This charge was frequently stated in the instructions from highest headquarters. Numerous examples might be cited, but the following statements published by Jonathan Letterman *(134)* are quoted as representing the best thinking of the time:

> The prevention of disease is the highest object of medical science.
>
> * * * * *
>
> * * * A corps of Medical officers was not established solely for the purpose of attending the wounded and sick; the proper treatment of these sufferers is certainly a matter of very great importance, and is an imperative duty, but the labors of Medical officers cover a more extended field. The leading idea, which should be constantly kept in view, is to strengthen the hands of the Commanding General by keeping his army in the most vigorous health, thus rendering it, in the highest degree, efficient for enduring fatigue and privation, and for fighting.
>
> * * * * *
>
> [The Medical Director should direct his Inspector] to instruct Medical officers in the proper mode of performing their duties, and particularly to impress upon them that the duties of Medical officers are not confined to prescribing drugs, but that it is also their duty, and one which is of the highest importance, to preserve the health of those who are well * * *.

Army Medical Museum established (1862); Army Medical School and General Hospital proposed.—Immediately after he was installed in office, Surgeon General Hammond set in motion many new proposals, recommendations, and activities *(135)*. When, in time, these became actualities, they greatly increased the efficiency, productivity, and prestige of the Medical Department. Several of them which influenced particularly the evolution of preventive medicine in the United States Army are summarized below, with comments:

1. An increase in the medical inspection corps by two medical inspectors general and eight medical inspectors.

2. An appropriation for the Army Medical Museum, which had been proposed in Circular No. 2 *(136)*. "Considerable progress has been made in the establishment of an army medical museum. The advantages to the service and to science from such an institution cannot be over estimated." A large part of the Army's laboratory system had its beginning in the Army Medical Museum, especially laboratories of pathology and bacteriology, and the Armed Forces Institute of Pathology.

3. The establishment of a central laboratory for chemical and pharmaceutical preparations for use by the Medical Department.

4. "An Army medical school, in which medical cadets and others seeking admission into the corps, could receive such special instruction as would better fit them for commissions." It was not until 1893, after Brig. Gen. George Miller Sternberg became Surgeon General, that the Army Medical School, the first school of preventive medicine in the United States, was established. Surgeon General Hammond noted that such a school might well be set up in connection with a general hospital and he recommended further that:

5. A permanent general hospital be constructed in Washington. "If this is done, the medical school and museum will be important accessories to it." From this conception, the Army General Hospital and the Army Medical School, in Washington, were united after the Spanish-American War to form the Walter Reed Army Medical Center.

6. Required surgeons to include in monthly reports case records, post mortem examination protocols, and much medical and surgical data, with notes on the relation of sanitation to prevalent communicable diseases. "Soon after my appointment I issued circulars [Circular No. 2, for example, cited above] to medical officers inviting them to cooperate in furnishing material for a medical and surgical history of the rebellion." In response, a large number

of memoirs and reports of great interest to medical science were received at the Office of The Surgeon General, collected and systematically arranged. This formed the substance from which the voluminous "Medical and Surgical History of the War of the Rebellion, 1861–65" was developed, and published during the period 1870 to 1888.

Treatise on military hygiene.—When Hammond became Surgeon General, there was no contemporaneous text in English dealing comprehensively with civilian public health or military hygiene. The only extant American publications on the subject were those of Benjamin Rush, John Jones, and Cutbush. In the first year of the Civil War, a small but useful handbook by Ordronaux *(137)* became available. Hammond noted that there were many excellent treatises in French and German, but recognized that they would not be serviceable for medical officers and others who could not read those languages. Therefore, to make up for this deficiency he wrote and published, in the midst of his almost overwhelming military-medical duties, devoting to it "the hours which would otherwise have been passed in rest," a 600-page volume on general and military hygiene *(138)*.

Hammond's "Treatise" antedated Parkes' "Manual of Practical Hygiene," *(110)* by a year and was highly informative for its time. As this work appeared before the bacteriological era its sanitary philosophy was based upon the older ideas about cleanliness, policing and quarantine, etc., often referred to in previous sections of this volume. Nevertheless, the book has a breath of vitality. It contains also a considerable amount of autobiographical material about Hammond himself and statements of his opinions. In producing this book, Hammond became the first of a succession of United States Army medical officers who wrote and published comprehensive treatises on military hygiene and preventive medicine.

Demobilization.—At the close of the Civil War in April 1865, although Hammond and Letterman had been out of the Army about a year, many of the promising undertak-

ings which they had initiated were well underway and were being supported by Hammond's successor, Bvt. Maj. Gen. Joseph H. Barnes (1817–1883), who had been appointed Surgeon General on 22 August 1864. As usual, however, in American military administration following a war, the United States Army, including its Medical Department, was drastically reduced. Most of the young men in the service left the Army for more interesting and profitable positions in civilian medical schools or in private practice. With a few notable exceptions, to be mentioned later, those who remained in control of the Surgeon General's Office were older men of the conservative or reactionary "clique," who appeared to believe that the peak of perfection of military science had been reached in the Civil War. The gadfly United States Sanitary Commission was disbanded soon after the close of the war, and the Medical Department's concern with military hygiene and preventive medicine reverted to a low level of routine application of old practices applied on a scale commensurate with the reduced and dispersed Army. This concern was lifted to a higher energy level by events that occurred from time to time, especially by the advent of the bacteriological era beginning in the second half of the 19th century.

CIVIL WAR TO SPANISH-AMERICAN WAR (1865–1898)

The 33 years from the end of the Civil War in 1865 to the beginning of the Spanish-American War in 1898 have been called by most historians of the period *(139)* "the day of small things in the United States Army." The Regular Army was reduced to about 25,000 men, stationed in small isolated posts, mainly in the Indian country in the Far West. The Medical Department consisted essentially of The Surgeon General with a small staff in Washington, a medical director for each geographical department, and a surgeon with a few assistants at each military post. In the field, brief but severe skirmishes with the hostile

Indians were frequent. There were epidemics of cholera and yellow fever in the Army, as among the civilians, in 1866, 1867, 1868, and 1873. In Washington, affairs pursued an almost peacetime course of military quiescence.

However, the appearance of smallness and lethargy were superficial. Actually, beneath the surface there was a seething of administrative and intellectual activity. In contrast with the ordinary affairs, several extraordinary movements and events, promoted by notable men, made the period one of the most significant in the history of preventive medicine in the United States Army. By the end of the period, modern preventive medicine had been created.

Before that stage is described, however, it will be advisable to notice briefly the progress made in several related activities.

Sanitary reporting monthly.—Increased attention was given to military hygiene at posts, stations, and camps. The consequential good results were shown in the decrease in the mortality from disease among troops to the low rate of 7 per 1,000 mean average strength for the year 1885. This was attributed to the strengthening of inspection, recommendations, and reporting by post surgeons which followed two vigorous reports by Assistant Surgeon John Shaw Billings *(140)*, and by new imperatives embodied in War Department General Orders No. 125, dated 17 November 1874, and a revision of Army Regulations 2315, dated 15 July 1885, reaffirmed as Army Regulations 1642, in 1889.

By this change in Army regulations, the monthly sanitary report, which was formerly only a requirement of the Office of The Surgeon General, was made a mandatory official procedure by the highest military authority. The post medical officer was required to submit to his commanding officer a report in writing, with recommendations. The commanding officer was required to indorse his actions on the report, whether approved or disapproved, and the indorsed report, with a copy of the indorsement given to the post medical officer, was sent to the Department Com-

mander, and thence to The Surgeon General. Army Regulations 1642 comprehended everything relating to the hygiene of the post or command to which the medical officer was attached. The stated examples of items to be covered were intended to be illustrations of the more important subjects for sanitary inspections and were not to be interpreted as restricting the scope of the sanitary report. The results were salutary. The reports submitted, resembling somewhat the comprehensive reports included in the "Medical and Surgical History of the War of the Rebellion," were often abstracted copiously or reproduced in full in the annual reports of The Surgeon General, swelling each report from a meager fasciculus to a respectable volume, packed with interesting information about the living conditions of the troops and about sanitary problems.

Although reiteration of recommendations and hammering on principles and cases was necessary to get action, this system of reporting and of procedures for handling the reports became respected and continued in effect into World War II. The multiplication of reporting units then caused desks to be piled to the ceiling with reports which could not be read in a lifetime, and the system sank under its own weight!

Medical Museum and the Surgeon General's Library.— The Army Medical Museum and the Surgeon General's Library, located in Ford's Theatre building on 10th Street near E Street, N.W., in Washington, appreciably increased their holdings and activities, each representing a type of organization and service which aided preventive medicine in the Army. During this period, the Museum, under Assistant Surgeon Joseph Janvier Woodward (who could not accept the germ theory of disease), became a world renowned center of photomicrography of microorganisms and tissues. The Library of the Surgeon General's Office, under the nurturing direction of Dr. John Shaw Billings, Assistant Surgeon, appointed librarian in 1865, greatly enlarged its collection of books, making available to Sternberg and others nearly all the foreign

literature of microbiology, particularly publications on the relationship of microbes to disease. The scientific support and influence upon preventive medicine provided by both of these great institutions has been continuous.

Physical standards and statistics.—Preventive medicine, concerned with human beings as individuals and as populations, has had an abiding interest in physical standards and in the relationship between anthropometric statistics and such matters as performance, durability, and susceptibility (of man) to disease. In 1875, through the efforts of the Surgeon General's Office and the Office of The Provost Marshal, an enormous collection of such statistical material, with calculations of rates, was issued *(141)* in two mammoth folio volumes. Similar colossal reports have been issued from time to time in connection with the characterization and management of troops in World Wars I and II.

BEGINNINGS OF SCIENTIFIC PREVENTIVE MEDICINE

Although the germ theory of disease was very old and had had vogues of favor, it became generally discounted between 1800 and 1850. This occultation occurred in spite of the acquisition and spread of a considerable amount of microscopically established knowledge of pathogenic bacteria, fungi, intestinal worms, and the itch-mite in scabies. In 1840, Jacob Henle (1809–1885) announced the theory of a *contagium animatum,* and at about the same time he formulated designs of experiments in pathogenicity which later, in the hands of his famous pupil, became "Koch's postulates." The classical taxonomic atlas of C. G. Ehrenberg (1795–1876), "Die Infusionsthierchen als vollwommene Organismen" (1838), was known in the United States to physicians who became military surgeons. Notably among these was Dr. Joseph Jones, Surgeon in the Provisional Army of the Confederate States, who during the Civil War observed bacteria in the lesions of hospital gangrene and

in the mesenteric lymph nodes and Peyer's patches in typhoid fever (undoubtedly seeing the typhoid bacillus fully 20 years before Eberth made similar observations). As early as 1846 and 1847, in Philadelphia, John Kearsley Mitchell had lectured medical students on his theory that malarious and epidemic fevers were caused by microorganisms. The expanded lectures were published in a book *(142)*. The remarkable "Treatise on the Practice of Medicine," by George B. Wood, M.D., Professor of Materia Medica at the University of Pennsylvania, published first in 1847 and republished in revised and enlarged editions until 1858, contained two large sections about animalculae in relation to diseases of men. Copies of this book were issued to regimental surgeons in the Union Army during the Civil War.

Through verbal dialectics, the anticontagionists got the upper hand over the contagionists, and the beliefs that miasmas, filth, and environmental factors were the chief causes of communicable diseases became firmly implanted in the lay and medical mind, although some diseases, such as venereal diseases, measles, and smallpox were admitted to be contagious. The experimental observations of microbiologists had not yet become sufficiently clear to be convincing *(143)*.

Beginning of the bacteriological era (1876).—Following the work of Louis Pasteur (1822-1895) (fig. 21) on spontaneous generation, fermentation and putrefaction, on diseases of silkworms and of beer and wine, and on anthrax, during the period 1857 to 1877—and following the investigations, technical innovations, and announcement of postulates as criteria for judgment by Robert Koch (1843-1910) (fig. 22), during the period 1876 to 1881, etiological discoveries were made in rapid succession. Reviewing these accomplishments, Dr. William Henry Welch, himself a contributor to them, said in 1914 *(144)*: "At the end of that wonderful decade, 1880–1890, perhaps the most wonderful decade in the history of medicine, there had been a revolution in medical thought through the discovery of the agents causing infectious diseases * * *."

FIGURE 21.—Louis Pasteur (1822–1895), founder of modern microbiology and immunology, and producer of experimental proofs of causes of infectious diseases. (Portrait photograph, courtesy of the National Library of Medicine, photograph negative No. 59–332.)

Lister's "System of Antiseptic Surgery."—Disinfection and the antiseptic treatment of wounds were of interest to American surgeons in the late 1870's as they were to Pasteur, Koch, and Lister (who began his work in this field in the 1860's). Some years before 1876, carbolic acid and salicylic acid were being used in surgery in the United States Army to prevent or mitigate wound infections. In 1876, however, two events of crucial importance occurred. Capt. A. G. Girard, Assistant Surgeon, attached to the Office of The Surgeon General, visited Europe where, in the clinics of Nussbaum and Volkmann in Germany and

FIGURE 22.—Robert Koch (1843–1910), discoverer of etiological agents of communicable diseases. The "bacteriological era" is arbitrarily dated from his demonstration in 1876 of the bacterial cause of anthrax. (Portrait drawing after a photograph, courtesy of the National Library of Medicine, photograph negative No. 3968.7.)

Austria, he saw the spectacular results obtained by the application of Lister's system of antiseptic surgery. Shortly after his return to Washington, his full account of the technique, materials and methods used, and evaluation of results was published in a circular by order of Surgeon General Charles Henry Crane *(145)* "for the information of Medical Officers of the Army." In 1876, the sprays, carbolized dressings, carbolized sutures, etc., were made articles of issue upon requisitions approved by The Surgeon General.

The other event of primary importance in this chain of circumstances was the attendance of Sir Joseph Lister

FIGURE 23.—Lord Lister (1827–1912), inventor of the "System of Antiseptic Surgery," which revolutionized surgical practice and furnished a spectacular example of preventive medicine. (Portrait photograph, courtesy of the National Library of Medicine, photograph negative No. 35904.)

(fig. 23) at the International Medical Congress held in Philadelphia in 1876 *(146)*.

Lister, who was president of the section on surgery at that congress, made forceful scientific statements, and took part in the vigorous discussion of his system of antiseptic surgery at the meeting. He said, among other things: "The germ theory of putrefaction is the foundation of the whole system of antiseptic surgery, and if this theory is a fact, it is a fact of facts that the antiseptic system means the exclusion of all putrefactive organisms."

Not all were convinced that the wound infections were caused by bacteria, but the discussion powerfully influ-

enced opinion toward acceptance of Lister's opinion that the antiseptic system meant the exclusion of bacteria from wounds by a chemical disinfectant barrier. The conception was essentially one of prevention. Hence, this system marked an advance in the practice of preventive medicine (including surgery) in both the civilian and military context. Undoubtedly, the success of antiseptic surgery, by supporting ideas about germs as causes of disease and about how to prevent their harmful activities, was a foundation pillar in the upbuilding structure of scientific preventive medicine.

George Miller Sternberg, pioneer bacteriologist. — The man who more than any other in the Army moulded events in preventive medicine *(147)* in the second half of the 19th century was George Miller Sternberg (1838–1915) (fig. 24), who after 32 years of service was appointed Surgeon General on 30 May 1893, and who held that position until he was retired for age on 8 June 1902. The decade of his surgeon generalcy was one of extraordinary accomplishment in preventive medicine. Most notable were the establishment of the Army Medical School, the establishment of a number of laboratories, the conception and skillful use of special scientific boards and commissions, particularly the Reed-Vaughan-Shakespeare Board on typhoid fever in the Spanish-American War, the Yellow Fever Commission in Cuba in 1900–1901, led by Walter Reed, and the Medical Section of the Philippine Board of Science.

General Sternberg, pioneer bacteriologist of North America, was self-taught. When he began his work, there were no bacteriological laboratories in the United States and no one on this side of the Atlantic to instruct him. He met Pasteur in Paris and Koch in Berlin only briefly in 1875. He began to study bacteria about 1870, if not somewhat earlier—possibly in the late 1860's, when he began to make photomicrographs at the Army Medical Museum where Assistant Surgeon Joseph Janvier Woodward was perfecting the technique.

In 1878, while stationed at Walla Walla, Washington, Sternberg began experiments to test the practical value

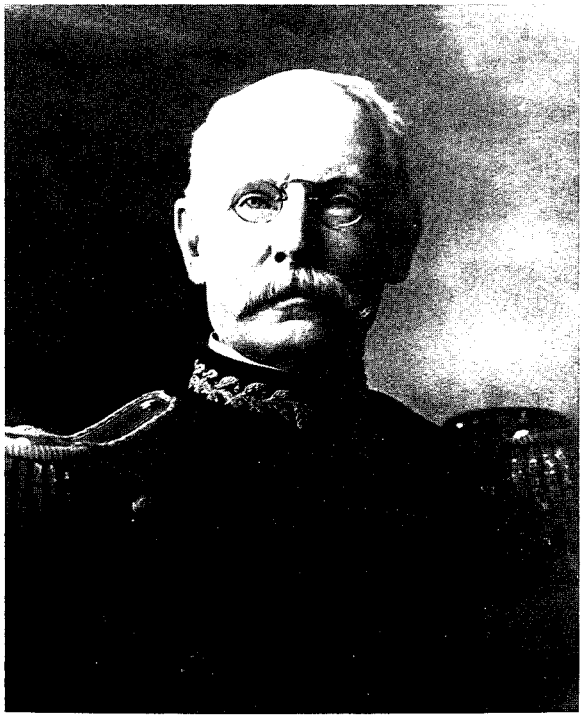

FIGURE 24.—George Miller Sternberg (1838–1915), Surgeon General of the United States Army (1893–1902). As a pioneer American bacteriologist, he helped to usher the "bacteriological era" into the United States. He founded the Army Medical School in 1893, appointed and supervised the Reed-Vaughan-Shakespeare Typhoid Board in 1898, and the Walter Reed Yellow Fever Commission in 1900. He established boards for the investigation and control of tropical diseases in the Philippines and Panama. (Portrait photograph, courtesy of the Armed Forces Institute of Pathology.)

of disinfectants, using cultures of putrefactive bacteria. From this, he went on through the next 20 years in work on cholera, yellow fever, septicemia (during which he discovered the pneumococcus in 1881), and in many ways exerted a new scientific influence upon attempts to prevent and control infectious diseases.

In his general writings, he was also extremely influential. In 1880, he published his translation of Antoine Mag-

nin's volume entitled "The Bacteria," which had been published first in Paris in 1878. This was the first systematic book of its kind in English. It was followed in 1892, by editions of Sternberg's classical "Manual of Bacteriology," and in 1896 and 1901, by editions of his "Text-book of Bacteriology." In 1895, in the vanguard of thinkers of the time, he published "Immunity: Protective Inoculations in Infectious Diseases and Serum Therapy," and in 1903, "Infection and Immunity with Special Reference to the Prevention of Infectious Diseases."

Sternberg's most prolonged, and apparently disheartening, bacteriological investigations were his attempts to find a bacterial cause of yellow fever. He found nothing etiological, but disproved the claims of several who thought that they had found the microbial cause of this disease. His results were so clearly negative that, as it turned out, they constituted a positive contribution. In showing that something besides a bacterium or protozoan parasite should be looked for, he cleared the way for Walter Reed and his associates in their quest which led to an invisible filterable virus.

Surgeon General Sternberg establishes the Army Medical School (1893).—On 24 June 1893 within a month after he had been appointed Surgeon General, Sternberg *(148)* obtained from the Secretary of War authorization to establish an Army Medical School in the city of Washington for "the purpose of instructing approved candidates for admission to the Medical Corps of the Army in their duties as medical officers."

Thus was implemented the recommendation that had been made by Surgeon General Hammond in 1862. By 22 September 1893, the school was organized and its first faculty announced. These were medical officers who were to teach in addition to their other duties. The first session of 4 months was commenced, with six students, in several rooms in the building of the Army Medical Museum and Library at 7th Street and B Street, S.W. (later Independence Avenue).

The first faculty of four professors included Maj. John Shaw Billings (later replaced by Maj. Charles Smart), professor of military hygiene, and Capt. Walter Reed, professor of clinical and sanitary science, and director of the pathological laboratory at the Army Medical Museum. There were courses also on "Duties of Medical Officers" and on "Military Surgery" in which information was given about Lister's system of antiseptic surgery. Among the special sessions, General Sternberg lectured on bacteriology, and Dr. Charles Wardell Stiles gave lectures on "Parasites in Man." In concordance with General Sternberg's leadership of the bacteriological era in America, strong emphasis was placed upon environmental sanitation, the microbial causes of communicable diseases, and upon scientific methods of prevention and control. Capt. Walter Reed's course was especially effective along these lines. It presented up-to-date exercises in experimental observations upon bacterial cultures, the inoculation of animals, and the recovery of bacteria from experimentally produced lesions *(149)*.

The Army Medical School was suspended in May 1898 because of the Spanish-American War. Reopened in the fall of 1902, it has continued since then in an uninterrupted progression of teaching, research, and service. As the first and oldest school of preventive medicine and public health in the United States, it has provided much of the precise knowledge which General Sternberg knew must form the core of modern scientific preventive medicine.

PART VII

The Spanish-American War—Tropical Preventive Medicine (1898-1914)

THE SPANISH-AMERICAN WAR (1898)

Only 118 days of hostilities were needed in the war between the United States of America and the Kingdom of Spain to create incredibly momentous changes in the affairs of the world. During this period, from the declaration of war on 21 April to the surrender of Manila on 16 August 1898 (4 weeks after the fall of Santiago, Cuba), Spain lost its vast possessions in Cuba, Puerto Rico, the Caribbean region, Guam, and the Philippine Islands *(150)*. The hitherto continentally centered isolationist United States, through mastery of those dominions, sailed out into the oceans as a world power. From this war, enormous and multiform consequences developed, many of which affected medicine and public health. Of these consequences, a few which importantly influenced the further evolution of civilian and military preventive medicine will be considered here.

Some medical aspects of the war with Spain.—In terms of men engaged and battles fought, the size of this war with Spain was small. However, the rapid assembling of a force nearly 10 times as large as the peacetime Army confused and taxed all bureaus of the War Department to the utmost. At the outset of the war in April 1898, the strength of the Army was 28,183 officers and enlisted men. In May 1898, the United States Army had been increased to

163,592, and reached 265,629 in July. The peak strength in August was 272,618.

Sickness and mortality.—Statistics of losses vary partly because the periods taken as bases for computation vary. According to figures supplied by the Medical Statistics Division of the Office of The Surgeon General on 22 June 1954, during the period of hostilities, the total deaths were 2,430. Of these, 369 were battle casualties (266 killed in battle; 103 died of wounds). The number of men who died of disease in this period was 1,939, mostly in the camps of volunteers in the United States as a result of typhoid fever. Sternberg, computing on the basis of the calendar year, May 1898 through April 1899, recorded 968 battle casualties and 5,438 deaths from disease. The mortality rate from disease was 27.13 per 1,000 mean strength per annum, and the ratio of deaths from disease to battle deaths was 5.6 to 1. (Some compute this ratio as 7 to 1.)

In Cuba, in addition to a small amount of typhoid fever, the diarrheas and dysenteries, malaria, and yellow fever attacked the troops almost as soon as they landed. The whole experience, including the gastrointestinal disorders from the eating of "embalmed beef," was one of such appalling sickness that the dissolution of the Army by disease was feared, and this forced a rapid withdrawal of soldiers from Cuba soon after the end of hostilities.

The work of the Medical Department during the Spanish War, together with an abundance of medical and sanitary data were copiously presented by Surgeon General Sternberg in his annual reports for 1898–1901, and in other publications *(151)*.

The principal lessons to be derived from the experiences recorded in these reports were stated by Surgeon General Sternberg essentially as follows *(152)*:

1. A trained medical corps of a small army can not control the sanitary situation when the army is quickly and largely expanded.

2. Physicians and surgeons from civil life, however well qualified professionally, as a rule are not prepared to assume the responsibilities of medical officers charged with

administrative duties and the sanitary supervision of camps.

3. Training and discipline are essential factors in the preservation of the health of soldiers in garrison or in the field.

4. Preparation by training and by systematic instruction in military medicine and hygiene, especially in camp hygiene, for both line officers and medical officers is essential. Preparation is a primary principle of preventive medicine. "In time of peace prepare for war."

Typhoid fever in military camps in the United States.—Typhoid fever broke down the strength of the commands generally through extensive prevalence among troops encamped within the limits of the United States during the months of May through September 1898. To investigate and report on the origin and spread of this disease, and on many related medical and sanitary matters, The Surgeon General in August 1898 secured the appointment of a board of medical officers.

The Reed-Vaughan-Shakespeare Typhoid Board.—The board was composed of Walter Reed, Major and Surgeon, U.S. Army, Victor C. Vaughan, Major and Division Surgeon, U.S. Volunteers, and Edward O. Shakespeare, Major and Brigade Surgeon, U.S. Volunteers. This board, known from the names of its members as the Reed-Vaughan-Shakespeare Board, carried out clinical, epidemiological, and etiological investigations, and rendered a famous report. Actually, the board published three versions of its report which are listed in chronological order *(153)*. (Excerpts from the second version of the report are reprinted in appendix B, p. 193.)

Investigations and report.—Material for the investigation was abundant. The total number of probable cases of typhoid fever among the 92 regiments studied was 20,738. Of these, 1,580 soldiers died, giving a death rate of 7.6 percent. The Reed-Vaughan-Shakespeare Board found among other things that:

1. The waterborne factor was not as important for the spread of typhoid fever as previously believed.

2. The spread of the disease was mainly by contact between persons, and by flies.

3. Human carriers (sick, immune, or well) of typhoid bacilli were important sources of typhoid infection.

"Report" (1899) and "Abstract of Report" (1900). — This point deserves emphasis. Walter Reed and his associates may not have known much about carriers when they started this investigation, but by the end they were able to make clear and strong statements on this subject. The following examples are cited from the "Report" and the "Abstract":

1. A man infected with typhoid fever may scatter the infection in every latrine in a regiment before the disease is recognied in himself. * * * The elimination of typhoid bacilli from the bowels probably begins soon after infection. If this be true, during the incubation period an individual may be a source of danger to others. Moreover, in most instances of typhoid fever the disease is not recognized in the prodromal stage, and during this time the excretions may be laden with typhoid bacilli. [Rep. (14), p. 663.]

2. Persons recovering from typhoid fever may continue for many weeks to eliminate in the urine millions of the Eberth bacillus. [Ab., p. 201.]

3. The typhoid bacillus may grow in the intestines of an individual and pass from the same without causing typhoid fever. * * * It is certain that an individual may become the bearer and distributor of the infecting agent of typhoid fever without developing the disease himself. [Ab., p. 202.]

4. The specific germ of the disease may be transported from one place to another in the intestines of an immune man, and when cast out in the stools may become a source of danger to others. It is probable in some such way as this that epidemics of typhoid fever sometimes appear to originate *de novo*. [Ab., p. 202.]

Typhoid carriers.—Historians, such as Ashburn, have either failed to read completely the text of the Reed-Vaughan-Shakespeare documents, or have misrepresented some of the statements. Some have written that while the important parts played by man-to-man transmission and

by the fly as an agent in the spread of typhoid fever were established by these investigators, the role of the human carrier was not appreciated at that time. For example, Ashburn's *(154)* comments were:

> Nobody knew anything about typhoid carriers. Nobody appeared to realize that men in the early stages, even in the incubation period of the disease, might be eliminating vast numbers of typhoid bacilli. * * * these facts * * * strongly suggest to the writer that the Reed-Vaughan-Shakespeare Board, the Medical Department, and the medical profession missed the best bet of the day.

This may have been true, to some extent, of the Medical Department and the profession. It is certainly not a fair statement of the insight and views of the Board. Indeed, if the Board had been heeded, the importance of carriers in the spread of typhoid fever would have been widely recognized as early as 1900, and the discovery credited to research in preventive medicine by medical officers of the United States Army.

The Dodge Commission Report (1899).—In the Spanish-American War, the Medical Department of the Army was inadequately equipped, both in personnel and material, to meet its obligations. Although much good work was done with inadequate means available, the Department was severely criticized, as was the whole War Department. On 8 September 1898, shortly after the close of the war, to get at the facts, President William McKinley, at the request of R. A. Alger, Secretary of War, appointed a commission to investigate the conduct of the War Department in the war with Spain. This commission, called the "Dodge Commission," after the name of its able president, Maj. Gen. Grenville M. Dodge, USA (Ret.), held 109 meetings, considered a vast amount of testimony, and rendered its report on 9 February 1899 *(155)*.

Army Medical Department reorganization.—In this influential report, which led eventually to a reorganization of the Army, there was published a large mass of testimony from all available sources concerning the Medical Department, with conclusions and recommendations. Brig. Gen. Robert Maitland O'Reilly, Surgeon General of the

Army from 1902 to 1909, and his assistants "accepted the conclusions of the Commission * * * as established facts, and its recommendations as an official and authorized statement of the future policy of the medical department." Indeed, this portion of the Dodge Commission Report was regarded as a charter for a reorganized and improved Medical Department. Surgeon General O'Reilly devoted his entire administration to the fulfillment of this charter. At the end he could report *(156)*: "the deficiencies have been almost wholly corrected."

The Congress passed laws to implement some of the recommendations of the Dodge Report. The War Department and its bureaus took appropriate action. The Medical Department moved in its field. Much of this activity had direct and indirect effects upon the organization and operation of preventive medicine in the Army. Emphatically, the commission had pointed out that because of the absence of a special corps of inspectors and the infrequency of inspections by chief surgeons "there was not such investigation of the sanitary conditions of the army as is the first duty imposed upon the [medical] department by the regulations." The remedy of sanitary deficiencies and the prevention of their reoccurrence thus received a strong impetus.

Among the legislative acts beneficial to the Medical Department and through that to preventive medicine were:

1. The establishment of a General Staff Corps and a Chief of Staff, with whom The Surgeon General could communicate directly.

2. Reorganization and redefinition of the Medical Department of the United States Army—which "from and after the approval of this Act [Act of April 23, 1908 (35 Stat. 66)] shall consist of a Medical Corps and a Medical Reserve Corps, the Hospital Corps, the Nurse Corps, and Dental Surgeons (later, in 1911, a Dental Corps), and provisions for paid veterinarians in 1901, and later in 1911, a commissioned Veterinary Corps."

3. Establishment of a Medical Reserve Corps by the Act of April 23, 1908, providing for a large group of highly

qualified physicians, surgeons, scientists, and specialists of many types from which essential skilled personnel could be drawn in times of need. Hundreds of officers who have contributed valuable services to preventive medicine in the Army have come from the Medical Reserve Corps.

Boards for the study of tropical diseases.—As a result of the Spanish-American War, the United States Army became one of the responsible agencies of the government in the administration of civil affairs-military government in such tropical dependencies as Cuba, Puerto Rico, and the Philippine Islands. The related and inevitable public health activities were urgent, novel, and replete with unsolved problems. Diseases peculiar to the tropics, and most of the diseases of temperate zones, were widespread among the inhabitants of these countries. They were a menace to the armies of occupation and a hindrance to the development of these regions. At that time, in 1898, little was known about the causes or the control and prevention of tropical diseases, although there was important basic new knowledge about the transmission of some diseases through biological processes of life cycles of protozoan parasites in arthropods. The transmission of malarial fevers by anopheline mosquitoes was proved by the results of the investigations of Sir Patrick Manson (fig. 25) and Sir Ronald Ross (fig. 26) during the years from 1894 to 1898. By 1893, in the veterinary field, Theobald Smith (fig. 27) and F. L. Kilborne had demonstrated the transmission of Texas fever of cattle by a tick. Keenly aware of the need to acquire essential knowledge, Surgeon General Sternberg, skillful in the selection and utilization of research teams, with characteristic foresight and initiative, obtained in 1900 the appointment by the War Department of two boards of medical officers to study tropical diseases in the places they occurred. The first was a board to study a variety of diseases, especially tropical diseases, in the Philippine Islands. The second was appointed for the purpose of investigating infectious diseases in Cuba, giving special attention to the etiology and prevention of yellow fever. Some account of these boards will be given to exhibit types of their scien-

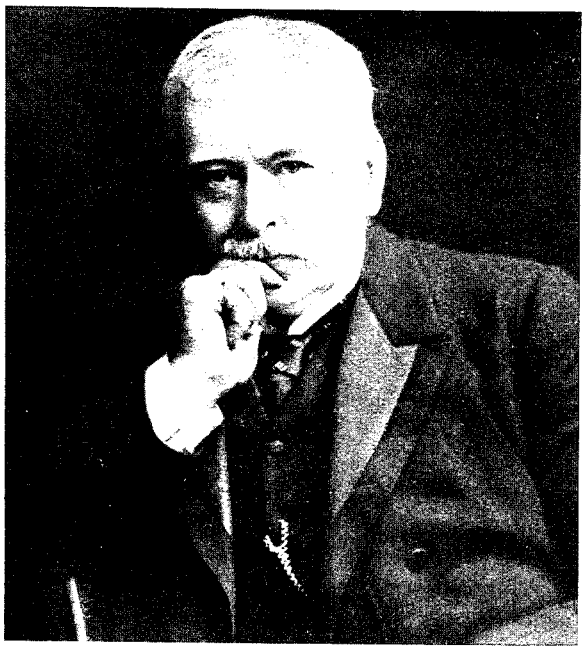

FIGURE 25.—Sir Patrick Manson (1844–1922), the "Father of Modern Tropical Medicine." In 1877, he demonstrated that the filaria of elephantiasis develops in, and is transmitted by, the *Culex* mosquito. This was the first proof of the spread of infection by an insect vector. In 1894, he announced his mosquito-malaria hypothesis. He became the inspirer and mentor of Ronald Ross. (Photograph portrait, courtesy of the National Library of Medicine, photograph negative No. 105547.)

tific contributions, and to signalize them as powerful mechanisms for the advancement of preventive medicine in the Army and in its civilian environment. It was a mechanism of which General Simmons, follower of Sternberg and a member of some of these boards in their early days, made effective use during World War II *(157)*.

Army Medical Research Boards in the Philippines (1900–1933).—During the 33 years, from 16 January 1900 to the end of 1933, except for a gap from 1902 to 1906, there was a succession of three United States Army Medi-

FIGURE 26.—Sir Ronald Ross (1857–1932). While in the Indian Medical Service, he demonstrated that an *Anopheles* mosquito was a vector of malarial fever, and later devised malaria control procedures based on antimosquito measures. (Portrait photograph, courtesy of the National Library of Medicine, photograph negative No. 32.497.)

cal Research Boards in operation in the Philippine Islands, with headquarters in Manila. These boards investigated many types of diseases prevalent in those Islands. In accordance with directives issued from time to time by the incumbent surgeon general, these boards were not restricted to investigations of diseases of human beings; they studied also diseases of cattle and other animals. The range of subjects of interest was broad, and the investigations were concerned with the biology and pathogenic

FIGURE 27.—Theobald Smith (1859–1934). One of the pioneers in the investigation of infectious diseases, he demonstrated in work with Kilborne that the protozoan parasite of Texas cattle fever was transmitted by a tick, providing another early convincing proof of an insect vector of communicable disease. His original description of anaphylaxis was called the "Theobald Smith phenomenon." (Portrait photograph, courtesy of the National Library of Medicine, photograph negative No. 6290.1.)

effects of practically all the classes of parasites. Medical entomology and metabolic disorders of man received a large share of interest. Among other subjects there were investigations on dysentery, cholera, and plague by 1st Lt. Richard Pearson Strong, MC (fig. 28), investigations on dengue by Lt. Col. J. F. Siler, MC, Maj. Arthur P. Hitchens, MC, 1st Lt. Charles F. Craig, MC, and Capt. James S. Simmons, MC. Craig and Ashburn showed that dengue fever was caused by a filterable virus, and Siler,

FIGURE 28.—Richard Pearson Strong (1872–1948). Long a member of the professorial staff of the Harvard Medical School, he was President of the Board for Investigation of Tropical Diseases in the Philippines (1899–1901). He conducted researches on many communicable diseases in many countries, including plague in Manchuria and typhus in Serbia. He was the author of a vast treatise on tropical medicine, conducted the course in tropical medicine at the Army Medical School during World War II, and served as an adviser to the Preventive Medicine Service, Office of The Surgeon General. (Portrait photograph, courtesy of the National Library of Medicine, photograph negative No. 10.777–A.)

Hitchens, Simmons, and others added much to the knowledge of the transmission of dengue by mosquitoes, chiefly, *Aedes aegypti*. Capt. E. B. Vedder, MC, made classical studies of beriberi. Capt. Raymond A. Kelser, VC, developed a vaccine against rinderpest in water buffalo. There were many important investigations on malaria. Nearly all of the

medical and veterinary officers who were members of these boards became leaders in various fields of preventive medicine in the United States Army during a period extending even to the end of World War II *(158)*.

Yellow Fever Board in Cuba (1900–1901); Reed, Lazear, Carroll, and Agramonte.—The second Army Medical Research Board, selected and established through the efforts of Surgeon General Sternberg, was appointed by the War Department on 24 May 1900 chiefly for the purpose of investigating, in Cuba, the cause, mode of spread, and prevention of yellow fever. Its president was Maj. Walter Reed (fig. 29), after whom the unit became known as the Walter Reed Yellow Fever Commission. The other members, able, original, courageous, indefatigable like their leader, were Drs. Aristides Agramonte, James Carroll, and Jesse Lazear. Working at Camp Columbia, at Quemados, and in Havana, the Reed Commission performed scientific miracles in a single year's span, 1900–1901.

Carlos Finlay and mosquito transmission of yellow fever.—The Reed Commission proved that yellow fever was caused by a filterable virus and confirmed the hypothesis of Carlos Finlay that the disease was transmitted by a mosquito (*Aedes aegypti*). By working out the cycle of the virus in man and mosquito, and by many other discoveries, the members of the Commission established principles and procedures that were to become determinative not only for the control and prevention of yellow fever by antimosquito measures (see appendix C, p. 201) and by immunization of human beings, but also for the whole category of insect-borne diseases. They made possible such gigantic accomplishments as the digging and building of the Panama Canal.

The dramatic story of the conquest of yellow fever of the urban type by Walter Reed and his associates is so well known that it is unnecessary to give further details here. Suffice it to cite a number of references to official, scientific, and biographical publications *(159)*.

An opinion expressed by Dr. William Henry Welch is an appropriate evaluation *(160)*. After saying that Walter

FIGURE 29.—Walter Reed (1851–1902), investigator of typhoid fever and typhoid carriers in Army camps in the United States in 1898, during the Spanish-American War. He was the planning and guiding force of the Yellow Fever Commission in Cuba in 1900–1901 which demonstrated that yellow fever was transmitted by the mosquito *Stegomyia fasciata*, later named *Aedes aegypti*. On the basis of findings he described measures for the control, prevention, and possible eradication of yellow fever. (Portrait photograph, courtesy of the Armed Forces Institute of Pathology, photograph negative No. WW–2545.)

Reed's contribution was comparable to Edward Jenner's he said: "The commission proved that complete eradication from the face of the globe of the greatest and most dreaded pestilence that affects mankind is possible. * * * It was an inestimable service to mankind."

In his draft "Introduction," previously referred to, General Simmons wrote: "This single contribution by the U.S.

Army to our basic knowledge of yellow fever stimulated the subsequent extensive researches of the Rockefeller Foundation and others, which have provided so much important information about yellow fever and have afforded the effective vaccine now used to protect American troops against this disease."

Hookworm disease in Puerto Rico; Ashford's work.— While stationed at Ponce, Puerto Rico, in 1899, 1st Lt. Bailey K. Ashford, MC, Assistant Surgeon, United States Army, began the study of "the severe anemia so common among the poor of this island." He found great numbers of the ova of the hookworm, *Ancylostoma duodenale,* in the feces of patients and proved that "Porto Rican anemia" or "tropical anemia" was caused by infestation of this parasitic nematode, to which attention had been directed by Dr. Charles Wardell Stiles, "the professor of helminthology at the Army Medical School," and a teacher of Lieutenant Ashford there in 1898. This work led to the worldwide campaign of the Rockefeller Foundation for the control of hookworm disease (ancylostomiasis). It strengthened the position of helminthology as a discipline of preventive medicine *(161)*.

ADVANCES IN THE EARLY 20th CENTURY (1901–1917)

Energetically animated by the brilliant discoveries and achievements just described, modern scientific preventive medicine advanced rapidly during the first 16 years of the 20th century. The period from the windup of the Spanish-American War in 1901 to the entry of the United States into World War I on 6 April 1917 was one of accelerating progress in preventive medicine in the United States as it was in Europe, both in civilian communities and in military organizations. Accompanying the scientific and administrative gains, and the appreciation of their immediate and potential power, a sanitary conscience was aroused. An impetus was imparted, which continues to

this day, to push forward the movement for improvement in military health.

Tropical medicine.—Epoch-making biological and sanitary work was done by Army medical officers in the tropical territory opened to the United States by the Spanish-American War. In praise of this period, Meleney *(162)* wrote in 1942:

> The Golden Age of Tropical Medicine in United States history was the first two decades of the present century, when yellow fever, malaria, hookworm, typhoid and the dysenteries were largely brought under control. Representatives of our Army and Navy Medical Corps and the U.S. Public Health Service were very important factors in this work, and the Bureau of Science in Manila gave experience to many men who have become our leading authorities on tropical medicine.

Highly important in tropical medicine were the convincing demonstrations of arthropod vectors of some of the chief diseases (malaria, yellow fever, filariasis, dengue), and the recognition of the seminal function of human and animal carriers of the agents of infectious diseases.

Havana freed from yellow fever and malaria reduced.—Early in 1901, the Chief Sanitary Officer of Havana, Cuba, Maj. William Crawford Gorgas (1854–1920) (fig. 30), accepted the evidence provided by the Walter Reed Commission that the mosquito, *Stegomyia fasciata* (*Aedes aegypti*), was the sole transmitter of yellow fever *(163)*. He was aware also of the recently proven transmission of malaria in man by anopheline mosquitoes. Therefore, with vigor and full support of General Leonard Wood (1860–1927), Governor General of Cuba, he attacked with two antimosquito brigades—an anopheles brigade and a stegomyia brigade. With the anopheles brigade, he achieved some reduction in the prevalence of malaria. With the stegomyia brigade, he drove yellow fever out of the city. Whereas in in the previous year, there had been approximately 300 deaths from yellow fever in Havana, after 26 September 1901, not a single case occurred. This was the first triumph over an insectborne disease of man based upon bionomics of the vector and knowledge of the cycle of the parasitic

FIGURE 30.—William Crawford Gorgas (1854–1920), Surgeon General of the United States Army (1914–1918). Applying methods based on the findings of the Walter Reed Commission he cleared Havana of yellow fever and, with a broad program of sanitation and disease control, made possible the building of the Panama Canal (1904–1914). (Portrait photograph, taken in 1901 when as a major, Medical Corps, he was Chief Health Officer of Havana, Cuba. Courtesy of the National Library of Medicine, photograph negative No. 54–184.)

virus. It is to be recalled, however, that the first control of an arthropodborne disease by attack on the vector was the prevention of tickborne Texas fever in cattle by Theobald Smith and F. L. Kilborne as the result of work begun in 1888 and published in 1893 *(164)*. The measures were simple, but their application and enforcement required hard work. With regard to yellow fever, the three main

preventive-control measures were: (1) prevention in every possible way of the breeding of *aegypti* mosquitoes in flowerpots, rainwater barrels, cisterns, fishponds, and collections of water in domestic environments; (2) prevention of mosquitoes from biting yellow fever patients (screening), and (3) destruction as far as possible of all mosquitoes that had bitten yellow fever patients (fumigation of rooms and premises).

Disease control and building the Panama Canal (1904–1914).—The construction of the Panama Canal was an Army job, carried through to completion in the 10-year period, 1904–1914, mainly by two branches of the Service —the Corps of Engineers and the Medical Corps. It is generally agreed that sanitation and preventive medicine under the direction of Col. William Crawford Gorgas, MC, formed the foundation upon which the engineers were able to build the Panama Canal *(165)*.

After his success in freeing Havana from yellow fever, in 1901, Colonel Gorgas surveyed conditions in Panama. He made it clear to Surgeon General Sternberg and other authorities that yellow fever, malaria, and certain other diseases so prevalent in the region would enormously hamper the work, and possibly defeat the United States' effort as they had destroyed the French, unless the new control measures that he had devised in Cuba were adapted to the Panamanian situation and rigorously applied. He was appointed Chief Sanitary Officer of the Panama Canal Zone in 1904 and at once set about his transforming work. In spite of the lack of full understanding and opposition of the engineers, he succeeded in freeing the Canal Zone of yellow fever in two years; the final indigenous case occurred there in May 1906. Malaria was greatly reduced by a variety of large-scale antimosquito measures, such as ditching draining, larviciding, fumigating, and screening. The pesthole of Panama, the "White Man's Grave," was changed to one of the healthiest communities in the world *(166)*.

In evaluating the accomplishment, Colonel Gorgas claimed that during the building of the Panama Canal the Sanitary Department had been the agency for the saving

of 71,370 human lives and the prevention of a vast amount of disability from sickness. More than this, he saw in the results the fulfillment of a cherished ideal in his geopolitical concept of preventive medicine. This was the demonstration that sanitation and preventive medicine would make it possible for the white man to thrive in the bounteous tropics. Finally, he wrote *(167)*:

> The discovery of the Americas was a great epoch in the history of the white man, and threw large areas of fertile and healthy country open to his settlement. The demonstration made at Panama that he can live a healthy life in the tropics will be an equally important milestone in the history of the race, and will throw just as large an area of the earth's surface open to man's settlement, and a very much more productive area.

Antityphoid vaccination.—Although typhoid fever among the troops of the United States Army declined to a low "normal" incidence after the severe epidemic of 1898, the dread of a resurgence of the disease continued. In discussions of the problem of control, Maj. (later Brig. Gen.) Frederick Fuller Russell, MC (1870–1960) (fig. 31), was one of the medical officers who were strongly of the opinion that there was a need for some method of preventing typhoid in addition to what the Army had available—some new measure that promised to give protection under all sorts of conditions, especially wartime conditions. Influential in raising the spectre of the disease was the experience of the British Army in the Boer War (the South African War), 1899–1902, in which that Army had 31,000 cases with 5,877 deaths from typhoid fever. It was during this war, however, that a new protective measure was devised and tested by Sir Almroth Wright (1861–1947); namely, antityphoid vaccination by subcutaneous injection of killed typhoid bacilli into soldiers. The method appeared to be successful, and, in 1908, Major Russell was sent abroad to study it. After his return in January 1909, his report was received favorably by a board of distinguished members of the Army Medical Reserve Corps. The procedure was approved and adopted for introduction in the Army *(168)*.

FIGURE 31.—Frederick Fuller Russell (1870–1960). In 1909, after making observations abroad, he introduced antityphoid vaccination in the United States Army. (Portrait photograph, courtesy of the Armed Forces Institute of Pathology, photograph negative No. WW–3041–A.)

Vaccination against typhoid fever, applied in limited stages in 1909, was made compulsory for the whole Army in 1911. At that time, and for several years thereafter, there were maneuvers of large bodies of troops in Texas, Arizona, southern California, and along the Mexican border. The sequel was spectacular. Vaccination with killed suspensions first of the Rawling's strain of the typhoid bacillus alone and later with a triple vaccine containing also paratyphoid A and B bacilli, was followed by a great reduction in admissions for typhoid, and in mortality from the disease. During one remarkable year, as reported by

FIGURE 32.—Joseph Franklin Siler (1875–1960), noted for investigations of mosquito transmission of dengue fever in the Philippines, for commanding the Laboratory Service in the American Expeditionary Forces in France in World War I, and for extensive experimental observations on the manufacture and immunizing efficacy of antityphoid vaccines. (U.S. official portrait photograph of Colonel Siler in his office at the AEF Central Laboratory, Dijon, France, 1918. Courtesy of the National Library of Medicine, photograph negative No. 28194.)

Siler (fig. 32), there were only 8 cases in a force of 100,000 in the field and no deaths *(169)*.

Most medical officers saw in these results an example of direct cause and effect. More critical officers, however, have pointed out that coincident with antityphoid vaccination there have been many improvements in many elements

FIGURE 33.—Carl R. Darnall (1867–1941), deviser of a method of purification (sterilization) of drinking water by treatment with anhydrous chlorine. (Portrait photograph, courtesy of the Armed Forces Institute of Pathology, photograph negative No. 519–1210–122.)

and facilities for sanitation of camps, marshes, and field positions. At the time of World War II, there were still unanswered questions as to the true efficacy of typhoid vaccination, but the evidence was regarded as sufficiently favorable to warrant its continued use, and the procedure had become "traditional."

Chlorination of drinking water by Darnall.—In addition to the activities of the Army Medical Research Boards in Cuba, Puerto Rico, the Philippines, and the work done in Panama, research by individuals elsewhere produced valuable results. The years 1910 to 1913 were especially fruit-

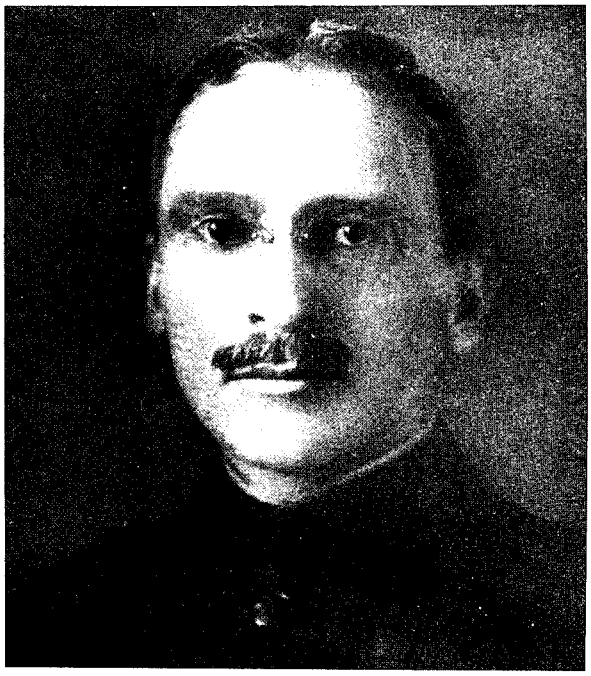

FIGURE 34.—William John L. Lyster (1869–1947), inventor of the "Lyster bag" in which drinking water may be sterilized in the field by addition of calcium hypochlorite. (Portrait photograph, courtesy of the Armed Forces Institute of Pathology, photograph negative No. 62–1590.)

ful. In 1910, at the Army Medical School, Maj. (later Brig. Gen.) Carl R. Darnall, MC (1867–1941) (fig. 33), devised the enormously useful system for the chlorination of drinking water supplies by treatment with anhydrous chlorine gas *(170)*.

The Lyster bag.—In 1913, Maj. (later Col.) William J. L. Lyster, MC (1869–1947) (fig. 34), invented the "Lyster bag" for the chlorination of drinking water in the field and in camps (and also in civilian locations) by the addition of calcium hypochlorite to the water *(171)*.

After it was noted that mental disorders were occurring

FIGURE 35.—Edward Lyman Munson (1868–1947). As President of the Army Shoe Board at Fort Leavenworth, Kansas, he guided the development of an improved shoe, called "the Munson last." This was an accomplishment of preventive medicine which contributed to the comfort of the soldier and increased the mobility of infantry. (Portrait photograph, courtesy of the National Library of Medicine, photograph negative No. 640.)

among soldiers during maneuvers along the Mexican border in 1911 at a rate higher than the civilian rate, increased attention was given to the possibilities of preventive neuropsychiatry. This phase of military preventive medicine took a definite upturn in this period.

The Army Shoe Board and the Munson last.—During the same period, the other end of the soldier's body—his feet—received careful and scientific study, with special reference

to footwear. Before 1912, a soldier was issued one pair of shoes which usually did not fit, cramping the toes, deforming the foot, and causing incapacity particularly on marches. To investigate this and reform the conditions, the able and thoughtful Army Shoe Board, formed at Fort Leavenworth, Kansas, in 1908, and directed by Col. (later Brig. Gen.) Edward Lyman Munson, MC (1868–1947) (fig. 35), issued its revolutionizing report in 1912. A new pattern of shoe, made on the Munson last was described, and methods for measuring and fitting were outlined. This shoe and related procedures were officially adopted *(172)*. This humble measure of comfort was a definite contribution by preventive medicine to the mobility of infantry, and as will be seen, socks and shoes had a determining influence on some phases of World War II.

Books on preventive medicine produced.—This period was also notable for the production of treatises on military hygiene and manuals of preventive medicine. After 1900, military sanitary officers published more books on these subjects than had appeared in many years previous to the bacteriological era. Particularly worthwhile for their times, and now as historical depictions of "the state of the art" on the eve of World War I, were the volumes by Munson, Ashburn, Havard, and Vedder *(173)*.

At this stage in the evolution of preventive medicine in the United States Army, there is discernible a preoccupation with massive procedures. With the individual in mind as a beneficiary, but with the Army in mind as the composite functioning organization to be preserved, measures were taken to make the mass invulnerable to disease germs by strengthening the internal biological mechanisms of the individual and by erecting external fortifications to noxious agents. Among the examples of both types of measures are vaccination of the thousands, detection and control of carriers, specific and nonspecific attacks on insect vectors, proper shoes for multitudes of feet, purification or chlorination of drinking water for all, and voluminous sewage disposal systems and plants.

PART VIII

World War I (1914-1919)

BEGINNING OF WORLD WAR I IN EUROPE (1914)

At the end of 1916, almost the whole of the United States Regular Army and the National Guard were mobilized in the Southern Department, chiefly along the Mexican border. This had come about through a series of annual training maneuvers starting in 1910, and through the punitive expedition into Mexico in 1916 when General Pershing led about 12,000 troops against the force under General Francisco Villa. In all of these situations, the health of the troops was remarkably good, attesting to the enforcement of measures of military hygiene which had been improved constantly since the Spanish-American War. No innovations in preventive medicine practice were made, but experience was gained, capable men were developed, and the preventive medicine component of the Medical Department was strengthened by the formation and training of additional units. Without a knowledge of what was hidden in the unforseeable future, a capacity to cope with problems that arose in 1917 was acquired from the basic experiences of the preceding 7 years.

The United States was alarmed by the attack of Austria on Serbia on 28 July 1914, and emotionally aroused by Germany's invasion of Belgium on 4 August 1914, which drew England and France into alliance with Russia, Serbia, and Belgium, signalizing the beginning of World War I.

During the next period of almost 3 years of anxious watching of the progression of the great war in Europe as it went against the Allies, much was done to prepare

the United States for the possibility of eventually joining in the conflict on the side of the Allies.

National Defense Act of 1916.—Of these preparatory actions, two were of major importance for the Medical Department. The first was the passage by the Congress of the Act Reorganizing the Army, 1916, better known as the National Defense Act *(174)*.

In addition to the indirect effects upon the organization, administration, and relations of the Medical Department, this Act contained several long sections of specifics. In referring to this Act in his Annual Report for 1916, Col. H. P. Birmingham, Acting Surgeon General in the absence of General Gorgas, who was in South America as a member of the Rockefeller Foundation's Yellow Fever Commission, wrote (p. 16): "As a result of legislation reorganizing the Army under the national defense act of 1916, the Medical Department was placed, for the first time in its history, upon a satisfactory basis." Seven medical officers were allowed for each 1,000 of the enlisted strength of the Army. The Dental Corps was reorganized and the probationary contract system was abolished, permitting immediate commissioning. The Veterinary Corps was established as an integral part of the Medical Department. Provision was made for the assignment of five medical officers for duty with the military relief department of the National Red Cross, and Col. Jefferson R. Kean, MC, "distinguished as a sanitarian and executive," was made first director general of military relief of the Red Cross, to the advantage of both the Red Cross and the Army. The details of this Act are too numerous to be mentioned here. Indeed, some of the provisions were so broad that only experience could disclose their content.

National preparedness and the Committee on Medicine.—On 29 August 1916, as one of the consequences of the National Defense Act, Congress created the Council of National Defense. It consisted of the Secretary of War, the Secretary of Navy, the Secretary of Agriculture, the Secretary of Commerce, the Secretary of Labor, with an advisory commission of seven, and with the power to estab-

lish such committees as might be needed. One of the groups established was the Committee on Medicine of which The Surgeon General, William Crawford Gorgas, was a member. This was important for military hygiene and sanitation of the Army. Among the other members, the three who were of special significance from the point of view of preventive medicine were Col. Jefferson R. Kean, Dr. William H. Welch (fig. 36), and Dr. Rupert Blue, Surgeon General of the Public Health Service. The functions of this committee are well indicated by the term "Medical Preparedness," including medical mobilization, the combating of venereal disease, and research in cooperation with the National Research Council *(175)*.

WORLD WAR I, USA PARTICIPATION (1917–1919)

When the United States entered World War I on 6 April 1917, military hygiene and preventive medicine in the Army, like public health and preventive medicine in civilian society, had attained competence in a variety of disciplines. Since the Spanish-American War, in addition to the general advances that had been made in knowledge and skill, and in the development of sanitarians, several special experiences had broadened the capabilities of the Medical Department to fulfill the first specified object of the sanitary service in war; namely *(176)*, "The preservation of the strength of the Army in the field by (1) the necessary measures; * * *. The initiation of sanitary measures to insure the health of the troops."

Military preventive medicine concerned with administration of the whole Army.—During most of the preceding 7 years, maneuvers in the Southern Department had provided practical experience in field sanitation, and the "Punitive Expedition" into Mexico in 1916 furnished campaign schooling. This capacity was expanded by the attitude and enlarged view of those who were primarily responsible for supervising the health of troops. Witnessing to this, the "Introduction" to the volume on sanitation in

FIGURE 36.—William Henry Welch (1850–1934). One of the founders of the Johns Hopkins Hospital and Medical School and Professor of Pathology, he became a world-renowned authority in bacteriology, public health, preventive medicine, and in many other fields. A wise and forceful medical and educational statesman, he rendered invaluable services to Surgeons General from Sternberg to Ireland, exerting a formative influence upon military preventive medicine—a force of global dimensions. (Portrait photograph of Dr. Welch as a colonel, Medical Corps, in World War I. Courtesy of the National Library of Medicine, photograph negative No. 1674.)

the official medical history of World War I begins with this statement *(177)*: "Military sanitation may be defined, in general, as the prevention of disease in armies. * * * [It] includes in its sphere both personal and public hygiene and in addition makes use of all the well-established procedures

which more recently have been grouped under the heading of 'preventive medicine.' " An additional guide to policy was the recognition that the activities of military preventive medicine extended beyond the limits of the command of The Surgeon General; they were concerned with the administration of the Army as a whole.

Furthermore, during the 3 years since 1914 when the great war began in Europe, there had been an opportunity for the Medical Department to study situations and make some preparations for possible eventualities. Through medical preparedness, as already outlined, the department had gained the support of the medical profession of the country and knew that in case of need, it could count on voluntary services of thousands of skilled physicians and surgeons, bacteriologists, epidemiologists, and public health experts. The National Research Council, which was to be enormously helpful, had been established by the National Academy of Sciences at the request of President Woodrow Wilson, in 1916, to mobilize the scientific resources of the country as a preparedness measure. Thus, at the outset of the American phase of World War I, the Medical Department of the Army was in better position than it had ever been at the beginning of any of its wars to render superior service. From the point of view of preventive medicine, it was capable of coping with the sanitary problems of the greatest military undertaking in the history of the United States up to that time. The health record would have been excellent if in the autumn of 1918 and subsequent winter the invincible pandemic of influenza had not deluged the world with sickness and death. Nevertheless, the death rate from disease in the total Army in World War I *(178)* was 14 per 1,000 average strength per annum, as compared with the rate of 25 in the Spanish-American War, and for the first time the ratio of battle deaths to death from disease was 1 to 1 (50,510 battle deaths—[37,568 killed in action; 12,942 died of wounds] —51,477 deaths from disease).

Mobilization and crowded camps.—In January 1917, practically at the start of the war, the strength of the

United States Army was approximately 200,000. Between 6 April 1917 and 15 November 1918, 3,704,630 men were mobilized in the United States. Many thousands of troops were called up rapidly, increasing each month, until during the year 1918 the numbers in camps in the United States averaged approximately 1,381,429 monthly.

Camps, hurriedly constructed, became crowded, and a series of epidemics of measles, mumps, and meningococcal meningitis passed through them. These were not too serious. The more damaging outbreaks were the epidemics of 1918—pneumonia (lobar pneumonia, and streptococcal bronchopneumonia and empyema following measles) and pandemic influenza. Influenza occurred also, but less severely among troops of the American Expeditionary Forces in France in 1918. The total number of deaths from influenza in the Army in 1918 was 23,000—a rate of 9.4 per 1,000 mean strength per annum. Nothing in the way of prevention or treatment of influenza was effective.

Pneumonia Commission established (1918).—To assist the Office of The Surgeon General in the investigation and control of these latter two groups of respiratory diseases, Surgeon General Gorgas secured the establishment by the War Department, on 20 May 1918, of a Pneumonia Commission (known also as the Pneumonia Board), composed of distinguished pathologists and bacteriologists, among whom were Drs. Rufus I. Cole, William G. MacCallum, Alphonse R. Dochez, Oswald T. Avery, Thomas M. Rivers, and Francis G. Blake. This Board not only rendered advisory service but also organized and directed the studies of groups of expert epidemiologists, bacteriologists, pathologists, and chemists who were sent into the camps to combat these infections. The Pneumonia Board functioned truly in the tradition of General Sternberg. It was the forerunner of the World War II Board for the Investigation and Control of Influenza and Other Epidemic Diseases in the Army. Established by the Secretary of War on 11 January 1941, this Board became known as the Army Epidemiological Board, and later, in 1950, as the Armed Forces Epidemiological Board. The Central Board and its

Commissions have dealt with hundreds of problems of communicable diseases among military personnel and environmental civilians, have assisted the Surgeons General of the Army, Navy, and Air Force in the formulation of sanitary policies and procedures, and they continue at this writing to render service of inestimable value.

Sanitary organizations in the Surgeon General's Office.—At the beginning of the war, Surgeon General Gorgas expanded his office to meet the wartime demands for disease prevention. The first step was to increase the responsibilities of the already conglomerate Division of Sanitation. This division had been in existence for many years and had been responsible not only for sanitation and preventive medicine but also for a variety of miscellaneous activities, such as the selection of recruits, the physical examination of officers and enlisted men, and the collection and analysis of statistics of morbidity and mortality. In April 1917, four new activities were added: (1) Hospitalization, (2) Medical Officers Training Camps, (3) Field Sanitation, and (4) Infectious Diseases and Laboratories. Later, the Division of Sanitation while becoming more complex in some parts of its anatomy, was simplified somewhat by an extirpation which created a separate Division of Infectious Diseases and Laboratories.

Thus, there were two divisions in the Surgeon General's Office which were concerned with preventive medicine; namely, (1) the Division of Sanitation, and (2) the Division of Infectious Diseases and Laboratories. It was difficult to draw a line between the responsibilities of these two divisions, and their overlapping jurisdictions were confusing. In theory, however, the relation between them was compared to the relationship which existed between a municipal board of health and its laboratories. The Division of Sanitation was the executive division so far as measures taken by the Medical Department for the prevention of disease among troops were concerned, while the Division of Infectious Diseases and Laboratories concerned itself largely with the scientific study of communicable diseases and with laboratory diagnosis. It used the

results of its studies as bases for recommendations for disease control.

It is worth noting particularly that the medical statistical operations of the Surgeon General's Office were located in the Division of Sanitation in recognition of the close relationship between the reporting of communicable diseases and their control. Telegraphic reporting of the occurrences of disease strengthened the control system *(179)*.

Sanitary inspectors.—A century before, enlightened and ingenious Surgeon General Lovell secured the establishment of the principle that medical officers should make sanitary inspections, locally and generally. Over the years since the issuance of War Department General Orders to this effect on 18 April 1818, such inspectors functioned from time to time, appearing and disappearing from the Military Establishment according to the whims of the Congress or the War Department, fulfilling inspectorial duties according to their inclinations. After the Spanish-American War, however, sanitary inspectors became more important and influential, and conscientious.

When the United States entered the war in 1917, sanitary inspectors who had proved their worth in maneuvers in the South and in the Mexican campaigns of the preceding years were on active duty. Many more sanitarian-officers of experience were added by General Gorgas to supervise sanitation in departments, armies, corps, and divisions, and even smaller units. Their presence, abilities, and influence throughout World War I imparted a special quality and efficiency to the military sanitary activities of American organizations both in the camps in the United States and in the campaigns of the AEF (American Expeditionary Forces) in France.

To the brilliant Sanitary Inspector of the Second Army, AEF, Col. Hans Zinsser (fig. 37), the Medical Department was indebted for an unusually thoughtful, analytical, and broadly conceived article on the theme of area sanitation —an article which has sometimes been reproduced in whole or in part without attribution of authorship *(180)*.

FIGURE 37.—Hans Zinsser (1878–1940), Professor of Bacteriology and Immunology successively at Stanford, Columbia, and Harvard Universities. As a bacteriologist, epidemiologist, sanitarian, and administrator, he directed communicable disease control and prevention activities in the American Expeditionary Forces in France in World War I. He was Sanitary Inspector of the Second Army at that time and published a general order on "Sanitation of a Field Army." Later he served as a consultant to The Surgeon General for the advancement of preventive medicine. (Portrait photograph of Dr. Zinsser, as a major, Medical Corps, in his laboratory office in France in World War I. Courtesy of the National Library of Medicine, photograph negative No. 11634.)

In this article, laboratory and epidemiological services are discussed in relation to the qualifications of the sanitary inspector. Dr. Zinsser wrote:

Just as the laboratory is of partial efficiency only in hospitals if the bacteriologist is unfamiliar with the cases in the wards, so in armies the laboratory service cannot be entirely efficient unless the

laboratory officer is trained in and in touch with the epidemiological data. For this reason, the Sanitary Inspector of the Army, who should be capable of acting as an adviser to medical officers and sanitary inspectors of the several troop units, should be a man not only trained in practical sanitation but one who at the same time is familiar with the facts of epidemiology, the methods of making epidemiological surveys, and can handle a laboratory for the control of communicable diseases as an important tool of his profession.

Sanitary Corps established (1917); reestablished (1923).—At the time when the United States entered World War I, only graduates of medical, dental, and veterinary schools were eligible for regular commissions in the Medical Department. As soon as activities and responsibilities were increased as a result of mobilization in April 1917, it became evident that the Medical Department would require the services of a considerable number of officers other than doctors of medicine, dentistry, and veterinary medicine. To meet this need, the President, moving by authority of the Act of 18 May 1917, " 'to increase temporarily the Military Establishment of the United States,' [directed that] there be organized under the Medical Department for the period of the existing emergency a sanitary corps consisting of commissioned officers." These officers would be provided by assigning officers of the Medical Reserve Corps thereto, or by the appointment of officers of the Medical Reserve Corps, or of citizens of the United States who had been found under regulations established by the Secretary of War to possess special skill in sanitation, in sanitary engineering, in bacteriology, or in other sciences related to sanitation and preventive medicine, or to possess other knowledge of special advantage to the Medical Department *(181)*. Grades and numbers were specified in the previously cited General Orders and in an amendment issued 2 months later *(182)*.

This authorization brought into the Medical Department sanitary engineers, psychologists, chemists, bacteriologists, epidemiologists, laboratory technicians, statisticians, adjutants, office experts, mess officers, supply and finance officers, and other categories not professionally medical.

A detailed history of the Sanitary Corps will be presented in another volume of the administrative series of the Medical Department, United States Army, and the valuable work of the Corps will be mentioned often in appropriate sections of this volume.

In World War I, the commissioned personnel grew to be upwards of 8,000 officers. After the end of the emergency, the Sanitary Corps was abolished by Section 10, Act of 4 June 1920, and it officially ceased to exist (for the time being) on 31 December 1920. It was reestablished in 1923 as a Reserve unit solely.

Gas defense and service.—Consultations relative to chemical warfare began between British, French, and American military representatives soon after the effective German chlorine gas attack upon French and Canadian troops in the Langemark sector on 22 and 24 April 1915. As a result of these conferences, on 5 November 1915, the furnishing of gas defense equipment was tentatively assigned to the Medical Department; and on 4 May 1917, the Secretary of War directed that The Surgeon General be informed that his Department would be charged with furnishing gas masks and other prophylactic (gas defense) apparatus for the Army. This responsibility was met by the Office of The Surgeon General. Overcoming many difficulties, the Medical Department carried on the work from that date until 28 June 1918, when gas defense ceased to be a function of the Department and was transferred to the newly established Chemical Warfare Service *(183)*.

Chemical warfare policies and missions.—From the beginning of this uncongenial task, it was recognized that the two main aspects of chemical warfare—offense and defense—were inextricably interwoven. This raised a serious moral and practical problem for The Surgeon General. While the Medical Department was dedicated to defensive and therapeutic measures—prophylaxis and treatment—it could not devise equipment and procedures for either without being familiar with materials, weapons, and tactics. In addition, it was necessary for some members of the Medical Department of the Army to participate in

some of the experimental and training phases of the use of poisonous gases in warfare. This Janus-like configuration which the Office of The Surgeon General was bound to assume in World War I continued through World War II, carrying over into concern with biological warfare; and to this day, it causes a somewhat schizophrenic behavior of the Army Medical Department. While these questions were and are ethically troublesome, the Medical Department could not and cannot avoid involvement in certain stages of offensive measures of chemical warfare up to their employment on the battlefield.

Sanitation of manufacturing and gas plants.—To produce the gas masks and other protective devices required by the War Department for the Army during the period when gas defense was a responsibility of the Office of The Surgeon General, it was necessary to construct and supervise a gas defense plant at Long Island City, New York, to manufacture equipment, etc., that was not procurable in commercial markets. This plant was authorized by the Secretary of War on 20 November 1917. It was built and managed by the Field Supply Section of the Gas Defense Service, which was directly under the Office of The Surgeon General. At the time of its peak of production in January 1918, this plant had 4,691 civilian employees. From its own manufacture, plus production from other plants under contract, 1.718,632 gas masks, and much other protective material, were produced and delivered.

It was soon obvious that this and related plans required sanitary supervision, specifically geared to the hazards, for the protection and care of workers serving under conditions in which there might be acute exposure to large concentrations of gas or prolonged exposure to small concentrations. The Office of The Surgeon General in collaboration with the Bureau of Mines of the Department of the Interior instituted a Sanitary Supervision of Gas Factories, both Government owned and operated and contractor owned and operated. The first chief of these activities in the Bureau of Mines was Dr. Yandell Henderson, Direc-

tor of the Experimental Physiological Laboratory. He worked closely with Capt. H. C. Bradley, SnC, who had charge of these affairs in the Sanitation Division of the Surgeon General's Office.

It is of particular interest to those familiar with the developments in sanitary supervision of industrial and governmental plants engaged in warwork in World War II to note that the first Medical Department participation in this beneficent work arose from the Army's concern with poisonous gases and chemical warfare. Later in a volume in the preventive medicine history series, it will be shown how large a development of activities in industrial and occupational hygiene was fostered and administered by the Preventive Medicine Service, Office of The Surgeon General, during World War II.

AMERICAN EXPEDITIONARY FORCES (1917–1919)

During the 2 years and one month between the declaration of war against Germany on 6 April 1917 and the signing of the Treaty of Versailles on 28 June 1919, the United States exerted a stupendous national effort in carrying out its strong part on the side of the Allies in World War I. As Surgeon General Merritte W. Ireland wrote in his letter of 8 October 1919, transmitting to the Secretary of War his annual report for that year:

> The period covered by the report of 1918 and by this one has been one of the most memorable in the history of this country. It has witnessed the inauguration, the full development, and the successful ending of the unparalleled activities of the War Department and of the Nation as a whole. Never before in the history of this country has the Government put so large an armed force into the field as during the year 1918.

This armed force was indeed formidably large, and the energy expended in assembling it, equipping it, and sending it overseas was prodigious. In the late fall of 1918, the total strength of the United States Army reached

3,704,630 men. Of these, approximately 2,000,000 were equipped for combat, preliminarily trained, and transported to France to form the American Expeditionary Forces. They served in camps, in the field, and fought great battles in 1918, from Chateau Thierry in July to St. Mihiel in September, and the Meuse-Argonne Campaign from 26 September to the armistice on 11 November. The citation of these figures and the mention of the campaigns and battles are enough to indicate the magnitude of the effort which the Medical Department was called upon to make both in the continental United States and in Europe to serve this Army in all of its situations—static and in motion, in safety and in peril, in threatened or actual sickness, and in the preservation of its health. As so much has been written *(184)* about the problems, exploits, and accomplishments of those days, there is no need to go over the well-known details here. Rather, an attempt will be made to present, in a sketched setting, several special developments and considerations which, while occurring in the AEF, were relevant to preventive medicine in the entire Military Establishment and contained some lessons for the future. The chief topics will be staff relationships, sanitary organizations and operations, and certain results.

Staff relationships.—(a) **The Theater of Operations, AEF, and the War Department.** In May 1917, an intrajurisdictional war was declared which through the involved divisions of the Medical Department had repercussions upon military preventive medicine. This conflict, inferential at first, was fought in strong disagreements later between the authorities of the AEF and the War Department, represented respectively by the Commander-in-Chief of the former, General John J. Pershing, and the Chief of the General Staff of the latter, General Peyton C. March *(185)*.

In General Orders No. 1, Headquarters, AEF, issued in Washington on 26 May 1917, General Pershing announced that he had assumed command of the AEF "pursuant to the orders of the President." By this, he indicated that he exercised virtually independent authority, under the Presi-

dent, over the Army Forces in France. According to his Chief of Staff, Maj. Gen. James G. Harbord *(186)*:

> General Pershing commanded the American Expeditionary Forces directly under the President and Secretary of War, as the President's *alter ego*. No military person or power was interposed between them. The President himself recognized this relationship, and the relative importance of the two Generals in it, when he returned to the United States in July, 1919, after the termination of the Peace Conference, by recommending to the Congress that Generals Pershing and March receive the permanent grade of General, but with precedence to the former.

Opposing this position, General Peyton C. March issued "by order of the Secretary of War" General Orders No. 80, War Department, Washington, 26 August, 1918. In this, among other statements, he announced that:

> The Chief of Staff by law (Act of May 12, 1917) takes rank and precedence over all officers of the Army, and by virtue of that position and by authority of and in the name of the Secretary of War, he issues such orders as will insure that the policies of the War Department are harmoniously executed by the several corps, bureaus, and other agencies of the Military Establishment, and that the Army program is carried out speedily and efficiently.

This statement was interpreted by General March to mean that the Chief of Staff was the superior of the Commander-in-Chief of the American Expeditionary Forces *(187)*.

General Pershing assumed and practiced command. In his final report, he devotes little or no discussion to the disputed question of authority; and in his later book about the war, he pays compliments to General March *(188)*. The question was not settled until after the war when the Army was reorganized in 1921. At that time, General Pershing was Chief of Staff as well as General of the Armies. He approved the recommendation of the Harbord Board that the Chief of the General Staff should be the commanding officer of the Army.

More than 40 years later, Edward M. Coffman reviewed the Pershing-March correspondence and many related papers. His summary and charitable conclusions were that the conflict was resolved. He wrote *(189)*:

Stories have multiplied since World War I about the so-called feud between March and Pershing. During the war there were differences, some of which were not worked out, but the legend outstrips the facts. The cables and Pershing's letters reflect dissension, but the March-Pershing wartime correspondence, although revealing disagreements, maintains throughout a friendly tone. Here were two men, both strong personalities, installed in positions and involved in a situation which invited trouble. Add the tension, the continual crises, and the awesome responsibilities of war to the traditional conflict between the line and the staff and the lack of a General Staff tradition, and friction becomes a natural result.

Staff relationships.—(b) The Chief Surgeon, AEF, and The Surgeon General, War Department. The disagreement over command affected many aspects of the military administration of the AEF, and exerted some influences upon the technical services of the Army. Undoubtedly, the point of view of General Pershing affected the attitude of General Ireland who, after serving as a most influential assistant to Col. (later Brig. Gen.) Alfred E. Bradley, MC, became Chief Surgeon of the AEF on 1 May 1918 and continued in that position until 9 October 1918. There was encouragement in the theater to the conduct of the Medical Department therein with an unusual degree of independence of the Office of The Surgeon General. In spite of this, or rather because of the magnanimity, the mutually respected abilities, and the cordial personal relationship of the two men in the highest medical positions (Generals Gorgas and Ireland), no impeding disagreements occurred. Nevertheless in World War I, precedents were set in the first great theater of operations overseas which in World War II tended to restrict the freedom of relations and communications between theater surgeons and The Surgeon General in all categories of military-medical activities, including those of preventive medicine.

From the start, very broad powers were conferred upon the Chief Surgeon, American Expeditionary Forces. On the recommendation of The Surgeon General (General Gorgas), the Secretary of War on 28 May 1917 designated Colonel Bradley "as chief surgeon United States forces in Europe," and in further accord with The Surgeon General's

recommendation authorized the Chief Surgeon "to exercise over the forces under your control the same authority as The Surgeon General holds over the entire Medical Department." During the remainder of the year 1917, the Office of the Chief Surgeon, AEF, was organized and operated along lines quite similar to those of the Office of The Surgeon General. However, with the authorization for semiautonomy exercised by a vigorous Assistant Chief Surgeon, Col. (later Maj. Gen.) Merritte W. Ireland, who shared General Pershing's philosophy and aims, the Medical Department of the AEF was modified in both personnel and equipment, and in its activities, to such an extent that the resultant changes bore but small resemblance to the existent tables of organization and equipment manuals. Such changes had to be made on the spot to meet the manifold new requirements of both trench and mobile warfare. Among the notable achievements of the medical administration of the zestful theater was the development of vigorous services of sanitation and preventive medicine. This was but natural under the encouragement and requirements of a Chief Surgeon who, reviewing his experiences 10 years later when he was The Surgeon General, emphasized the importance of sanitation, sanitary inspectors, epidemiologists, and laboratories. He wrote *(190)*: "Probably no activity pays in the military service such huge dividends as preventive medicine."

Another important difference was the relation between the Chief Surgeon and the Commander-in-Chief and his Staff at General Headquarters, American Expeditionary Forces. The Chief Surgeon and a small group of medical officers were members of the staff at general headquarters, members of the commander's family, as George Washington expressed it. There they dealt with policies, plans, and a broad range of military medical coordination. The Office of the Chief Surgeon, Line of Communications (later Services of Supply), handled most of the details of operations, such as supply, hospitalization, personnel, etc. Thus the Chief Surgeon, AEF, was in far more intimate association with the top American command in France than

was The Surgeon General, in relation to the General Staff and the War Department in Washington. General Ireland insisted successfully that a first necessity was the recognition of the surgeon as a staff officer and his inclusion in the councils of command. This is also an important principle for chiefs of services of preventive medicine, for as representatives of their chief surgeons they need to receive, as a basis for intelligent action, the kind of information that derives from the staff status of the surgeon of the command.

Sanitation in the AEF.—The sanitary organizations and the men in charge of them were all important. In the Office of the Chief Surgeon, there were two main divisions for operations of military hygiene—a Division of Sanitation and Inspections, and a Division of Laboratories and Infectious Diseases, with which a Section of Epidemiology was closely associated. The Division of Sanitation eventually became, in a large measure, an office of preventive medicine wherein all activities relating to that subject were centralized. The Division of Laboratories and Infectious Diseases, coupled with Epidemiology, functioned in the closest possible cooperation and support with the Sanitation Division. At the head of Sanitation was the distinguished health officer and scholar of public health, brought into the service from civil life, Dr. (Colonel, MC) Haven Emerson; and high ranking in the Division of Laboratories and Infectious Diseases was Dr. (Lieutenant Colonel, MC) Hans Zinsser, world-renowned bacteriologist, immunologist, and epidemiologist, who was also in the closing months of the war Sanitary Inspector of the Second Army.

Special features of the Division of Laboratories and Infectious Diseases were its centralized and decentralized laboratories for diagnostic services, control procedures, and research. The main Central Medical Laboratory, established at Dijon in January 1918, was under the direction of Col. Joseph F. Siler, MC, and had connections with many other laboratories in headquarters, field armies, corps,

divisions, hospitals, and certain special units such as engineer water supply battalions.

Results and the influenza pandemic (1918–1919).— Without recapitulating details which had been set forth profusely in the historical volumes cited in this section, it can be affirmed that while nothing particularly new in preventive medicine was developed in the AEF, the application of known methods and the adaptation of measures to the situations of the campaigns in France in 1917-1918 were carried out with an unusually high degree of thoroughness and intelligence. Inevitably, sanitation in some units was much better than in others, and sanitary practices broke down in a number of circumstances, as during and after a battle. On the other hand, except for the outbreaks of influenza, the insidious recurrences of diarrheas, and the extensive prevalence of lousiness due to lack of bathing facilities and scarcity of clean clothing, there were no extensive afflictions of the troops by diseases. The general health of the AEF was good.

OCCUPATION OF GERMANY, UNITED STATES ARMY ZONE (1919)

Among the concluding engagements of the AEF, the occupation by the Third Army of a part of the German Rhineland involved two major activities pertinent to this monograph. These were (1) sanitation and preventive medicine in the Army of Occupation, and (2) public health activities of Civil Affairs-Military Government in the occupied area. In the evolution of preventive medicine in the United States Army, both of these phases of the work presented new situations and new policies and principles, for the administration of which practically no preparation had been made. As a consequence, elementary experience was gained and basic concepts developed. The lessons learned, or displayed, were potentially important guides for the future, but they received only superficial notice until about 1939, when the United States began to prepare for World War II *(191)*.

The Third Army, Maj. Gen. Joseph T. Dickman, commanding, was activated at Ligny-en-Pavois, Meuse, France, on 7 November 1918, 4 days before the armistice was signed. Its mission, assigned soon after the armistice on 11 November 1918, was to serve as the Army of Occupation in Germany, in an American zone. In a strength of approximately 260,000, it marched from France through Luxembourg and the Treves (Trier) region to Coblenz and beyond, to occupy the Moselle area of Germany from the eastern boundary of Luxembourg to the western bank of the Rhine and the northerly half of the bridgehead of 30 kilometers radius east of the Rhine, centered at Coblenz. Upwards of 1,000,000 civilians and an unknown number of disarmed German soldiers were in this region.

Third Army sanitation, preventive medicine, and health.—The Office of the Chief Surgeon, Third Army (Col. Jay W. Grissinger, MC), at Army Headquarters at Coblenz included an enlarged Division of Sanitation presided over by the Army Sanitary Inspector (Maj. Stanhope Bayne-Jones, MC) and the Army Epidemiologist (Maj. Alan M. Chesney, MC). Higher authority had decided, correctly as events proved, that as the Army of Occupation was stationed in a fixed area with divisions and other large units in stabilized positions, there was no need to install an Army-area system of sanitation and preventive medicine. The corps, divisional, and regimental medical groups could be depended upon to carry out in their areas all the work necessary for the preservation of the health of the troops. The important sanitary matters that required some degree of centralized operation by the Army were attempts to reduce venereal diseases by control of houses of prostitution, the supply and control of drinking water, and the enforcement of safeguards against the consumption of vegetables contaminated by the German practice of fertilizing fields with emulsions of human feces sprayed from "honey carts" that had been filled from cesspools.

The office of the sanitary inspector and epidemiologist maintained from inspections and reports a ledger of cases of communicable diseases and a huge spot-map of the

Army area affixed to the walls of a room in the spacious German building in which the Chief Surgeon's office was located. Here data on the incidence of diseases were compiled and analyzed and a Weekly Health Bulletin was composed for issuance by the Office of the Chief Surgeon. There were brief outbreaks of influenza and typhoid fever among the troops in 1919, and some diphtheria. However, communicable diseases were not excessive in the Army of Occupation *(192)*.

Civil affairs-military government public health.—The I. L. Hunt Report *(191)*, previously cited, severely criticized the general conduct of civil affairs-military government by the Third Army in Germany in 1919–20. After reviewing events, the author of chapter IV (p. 65, vol. I) wrote:

> The conclusion from these facts is incontestable; the American army of occupation lacked both training and organization to guide the destinies of nearly 1,000,000 civilians whom the fortunes of war had placed under its temporary sovereignty. * * * There can be no doubt that the belief felt in many quarters * * * that the armies could occupy enemy soil and yet divest themselves of responsibilities of government, was both prevalent and powerful.

Such strictures could not be applied to the public health activities of civil affairs-military government of German territory occupied by the Third Army from 7 December 1918 to 31 May 1919. Health conditions among the civilian population were of vital concern to the Chief Surgeon of the Army and to the Chief Sanitary Officer in Civil Affairs at Advance Headquarters, AEF, at Trier.

The Department of Sanitation and Public Health in the office of Civil Affairs-Military Government in German occupied territory was established pursuant to General Orders No. 1, Advance General Headquarters, AEF, Treves, Germany, 18 December 1918, to supervise and control civil sanitary service in the occupied area with a view to protecting the health of the troops of the American Army of Occupation and of guaranteeing to the civil population adequate medical service. This department was directed by a Chief Sanitary Officer, Lt. Col. Walter Bensel, MC, a medical Reserve officer called to active duty from the

New York City Department of Health, where he had had a long experience. He kept in close touch with the Chief Surgeon of the Army. In the official Army medical history of that period, the coordination of the civil and military sanitary service was appraised in terms of satisfaction, as follows *(193)*:

> As the German public health service appeared to be adequate and sufficient for the needs of the civil population, the manifest policy was to continue the organization in force, with such supervisory control and assistance by the American Military Establishment as might be found necessary. This was satisfactorily effected by directing division commanders to supervise the administration of the civil sanitary service within their divisional limits. As these areas corresponded fairly closely with administrative areas, division surgeons were enabled to cooperate effectively with the local health officer, obtaining from him information concerning the health of the civil population and the sanitary conditions and at the same time giving him information concerning the health conditions of the military units. In this the work of the civil and military organizations was coordinated, each reporting to the other essential data affecting public health.
>
> Reports from division surgeons of cases of communicable disease in both civil and military populations reached the office of the chief sanitary officer through the chief surgeon, Third Army. Weekly reports of communicable diseases in the civil community were also received from the chief German sanitary official of the district of Treves and of Coblenz. Cases of typhoid fever were in addition reported from the director of the German laboratory at Treves. Division surgeons made a special monthly report to the chief sanitary officer through channels regarding important matters pertaining to public health and sanitation in the civil population, a separate report being rendered for each administrative area. Thus reports were received and tabulated from both civil and military sources enabling the chief sanitary officer to keep in touch with health conditions in both communities.

Typhoid fever (especially at the towns of Brück and Alternach on the Ahr River), diphtheria, and influenza were occurring in the civil population under conditions favorable to their transmission to troops. That such transmission did not occur to any appreciable extent was due in largest measure to the coordination of the civil and military sanitary services.

Discontinuance of Third Army.—After the Germans signed the peace treaty of Versailles on 28 June 1919, American troops were speedily returned to the United States. The Third Army was inactivated on 2 July 1919, and the American Forces in Germany, a force of about 8,000 men, came into being in the area of occupation. The Department of Sanitation of the original section of Civil Affairs-Military Government of the American Forces in Germany was terminated in a practical sense on 10 January 1920 when the Inter-Allied Rhineland Commission became the supreme Allied authority in the occupied territory.

PART IX

Two Post-War Decades (1919-1939)

A PERIOD OF PEACE, PROGRESS, AND PERIL

The two decades following World War I, viewed within the United States, appeared to be peaceful as the country was not engaged in any war. With this feeling, a draft of an account of the period from January 1919 to 3 September 1939 was captioned: "Two Decades of Peace." On the contrary, it was the superficial peace of timbers supporting an overwater pierhead while teredos were gnawing their interior substance. When globally scrutinized the period is seen to have been troubled by economic crises, disturbed by discords, roiled by violent tyrants, convulsed by revolutions, and racked by three prophetically ferocious wars in Europe, Africa, and Asia. The seeds of the Second World War were planted in the conferences in Paris and the treaty of peace of Versailles in 1919. They germinated in the first decade of the 1920's. The resulting growths in the 1930's and the worldwide economic crisis of 1929 produced World War II, among the myriad consequences of which were basic, practical, and maturing effects upon military preventive medicine.

Consideration, mostly by means of brief summaries, will be given here of some general, scientific, educational, and organizational events which contributed to the evolution of preventive medicine in the United States Army in this period. Such summaries and notes will bring this monograph to a close.

Both teaching and research were continued at the Army Medical School in Washington, D.C., at the Medical Field

Service School at Carlisle Barracks, Pennsylvania, in the laboratories of the Army Medical Department Research Boards in Manila and Panama *(194)*, and in various other military hospitals and stations. The Sanitary Corps was reestablished as a Reserve organization in 1923.

Educational resources for preventive medicine.—Educational resources for preventive medicine developed through the scientific advances of bacteriology and the facilities provided for the work in that science. In 1888, after his return to Ann Arbor from a period of study in Robert Koch's laboratory in Berlin, Victor Vaughan secured a grant from the State of Michigan to build and equip a hygienic laboratory at the University of Michigan. This laboratory was one of the first to give advance degrees in the field of sanitary science. During the years from about 1885 to 1890, a number of bacteriologists and hygienists in Ohio, Michigan, Wisconsin, Massachusetts, Maryland, and the District of Columbia provided instruction in hygiene. These men included, in addition to Vaughan, E. A. Birge, H. C. Ernst, William H. Welch, Theobald Smith, W. T. Sedgwick, and George Miller Sternberg.

Schools of public health in the United States.—In a more formal manner, schools of public health were established in the United States. The first school of training in public health and preventive medicine in this country was the Army Medical School, established by Surgeon General Sternberg in Washington, D.C., in 1893. A school of sanitarians at the Massachusetts Institute of Technology was initiated as a result of Sedgwick's epidemiological investigations in the 1890's. This merged with Harvard University in 1913 forming the Harvard-MIT School of Public Health, and became the first civilian school of public health. It was reorganized in 1918 and named the Harvard University-Massachusetts Institute of Technology School of Public Health. In 1922, it was separated from MIT and thereafter has been designated the Harvard School of Public Health. The Johns Hopkins University School of Hygiene and Public Health was formed and put into operation in 1918. In succeeding years, these were followed by

schools of preventive medicine and public health at six more universities. All furnished a type of education and training that was utilized for enhancing the competence of military preventive medicine officers. Thus they served to increase the numbers of those specialists so much needed by the Army.

Epidemiology broadened.—Epidemiology as a discipline in military preventive medicine came into special prominence in the American Expeditionary Forces in France in 1918–1919, as previously noted. Epidemiology made further gains, starting about 1920, when "in the minds of many," in America and in Europe, "realization took form that disease was no longer being studied, but rather parts of disease;" that too much attention was being devoted to the infectious agents of communicable diseases to the neglect of noncommunicable diseases and the factors of host, environment, and cultural and social conditions as determinants of health and disease in groups of people. As Gordon *(195)* has expressed it, an epidemiology of noncommunicable diseases came into being; there was a return to a holistic interpretation of both community disease and sickness or injury to the individual. Epidemiology, now recognized as a part of medical ecology, was enriched and strengthened. In addition, sanitary engineering, called also environmental engineering, attained recognition as a discipline capable of making large contributions to the understanding, prevention, and control of numerous diseases.

Coincident with the increase in educational facilities and the rise of new ideas, several notable books appeared. Of particular value to practitioners of preventive medicine were: (1) the fourth (1921), fifth (1927), and sixth (1935) editions of the epochal "Preventive Medicine and Public Health" by Dr. Milton J. Rosenau; (2) "Military Preventive Medicine," third edition (1938), by Lt. Col. George C. Dunham, MC (fig. 38) and (3) the third (1929) and fourth (1935) editions of "Laboratory Methods of the United States Army," edited by Maj. James Stevens Simmons, MC, and Maj. Cleon J. Gentzkow, MC.

Throughout these two decades, the troops of the United

FIGURE 38.—George C. Dunham (1887–1954), teacher, preventive medicine officer, author of the standard textbook "Military Preventive Medicine." As Director of Health and Sanitation, Institute of Inter-American Affairs (1942–1945), he advanced international civilian and military preventive medicine. (Portrait photograph, courtesy of the Walter Reed Army Institute of Research.)

States Army lived in well-sanitated garrisons. The overall health record was excellent, except during occasional field maneuvers when certain disease control measures could be applied only with difficulty, or inadequately.

Malaria threat recognized.—For example, the malaria rate of the total Army during 1939 was only 4.9 per 1,000 mean strength per annum, which was the lowest rate since the American Revolution. At about that time, however, it was realized that this excellent record could not be maintained if the country became engaged in a war

in a tropical malarious region. For years, United States troops had contracted malaria in the Philippines and Panama, and on one occasion the field maneuvers of an infantry regiment in Panama in 1935 had to be abandoned because of the high malarial infection rates. Commenting on this, General Simmons, then a lieutenant colonel, wrote in 1938 *(196)*:

> Such occurrences show the importance of malaria as a military problem and indicate the need for the development of more effective methods for the prevention of this disease in the field. The difficulties encountered by troops living under the relatively favorable peacetime conditions which exist in the Canal Zone afford a serious warning of the dangerous situation that would undoubtedly arise should it become necessary for our Army to operate for a long period in the American tropics.

This prediction was substantiated within a few years by the tropical experience of American troops in World War II.

Atabrine introduced as substitute for quinine.—In view of the needs that developed in World War II for antimalarials other than quinine, which became scarce, it was fortunate that Atabrine (quinacrine; mepacrine) was introduced as a substitute for quinine in 1932, and that as early as 1933–1935, medical officers in Panama had an opportunity to test this new drug for its effectiveness in the treatment and suppression of malaria. This marked the beginning of extensive new chemical and pharmacological research on substances for use in combating malaria.

Chemotherapy and chemoprophylaxis.—At about the same time (1932–1935), there were revelations, almost miraculous in the field of chemotherapy and chemoprophylaxis of bacterial infections. Prontosil, and a variety of sulfonamides (sulfadiazine, etc.) were shown to cure and prevent infections by streptococci, meningococci, gonococci, and many other species of pathogenic bacteria. Powerful new antibacterial drugs became available as reinforcements for preventive medicine. Furthermore, by curing clinical, inapparent, and latent infections, these drugs

eliminated carriers, thereby reducing the reservoirs of infection in populations and communities. The consequent reduction of the degree of infectious potential was a forceful new measure for the control of epidemics.

Other biological advances made in these two decades still further strengthened means for the prevention and control of communicable diseases. Particularly valuable were improvements in methods of identifying bacteria by serological typing and by bacteriophagic lysis, enabling the sanitary sleuth to follow and recognize the microbial culprit. Serological epidemiology was created by these discoveries and practices.

Penicillin discovered (1929) and antibiotics produced.— In addition, in about 1921, the science of virology was aroused by new investigations from the rather lethargic state in which it had existed since 1891 when viruses were discovered. Simultaneously there was an acceleration of acquisition of new knowledge about the rickettsiae and rickettsial diseases, such as the typhus fevers and Q fever. The more it became possible to make differentiations among micro-organisms and among communicable diseases, the more epidemiology and preventive medicine gained in precision and power. Finally, a whole array of new phenomenally curative and preventive agents—the antibiotics—became available after the discovery of penicillin in 1929.

Civilian Conservation Corps (1933–1942).—The Medical Corps, responsible for medical care and supervision of the health of the thousands of young men who served in the camps and works of the Civilian Conservation Corps from 1933 to 1942, had extensive experience in the control of typhoid fevers by the use of triple TAB vaccine. According to the final report of the investigators *(197)*: "The influence of protective immunization in the prevention of typhoid fever has been well demonstrated in the Civilian Conservation Corps."

Status of the Preventive Medicine Unit in the Surgeon General's Office (1919–1939).—The position, or status, of the unit for preventive medicine in the organization of the

Surgeon General's Office rose and fell periodically during the 20 years from 1919 to 1939. Reorganizations and juggling nomenclature were habitual with this office during that period as they were in World War II and have been since. During the two decades, there were four surgeons general, and each reorganized the office relinquished by his predecessor. Sometimes a surgeon general would reorganize his own reorganized office. From 1919 to 1925, preventive medicine was included in the Sanitary Division. In 1925, the name of this division was changed to Preventive Medicine Division and all of the professional activities of the Sanitary Division were taken over by the Preventive Medicine Division. Within a year, however, it was demoted to a subdivision or subsection of the Professional Service Division, and remained in that status until after the start of participation by the United States in World War II.

During these reorganizations there was a saving sense of the significance of preventive medicine and some recollection of the high position and reasonable independence of the subject that had been so clearly appreciated in the AEF in France in World War I. This conception came to the fore in the latter years of the second decade between wars when studies were being made of plans to adapt the Surgeon General's Office to meet demands in case of war. "The Surgeon General's Protective Mobilization Plan," which appeared in final form in December 1939, recognized the wartime importance of preventive medicine.

LEADERSHIP IN PREVENTIVE MEDICINE— THE SIMMONS REGIME INITIATED

As no mobilization plan is self-implementing, competent men would be needed to put The Surgeon General's plan into effect at the proper time. Each section of the plan required an imaginative and forceful leader. Fortunately for the future, vast development of preventive medicine activities in the Office of The Surgeon General, and indeed in the Army as a whole, the right man for this work was already tentatively selected, prepared, and readily avail-

FIGURE 39.—James Stevens Simmons (1890–1954). Climaxing a medicomilitary career as an investigator of infectious diseases, as an epidemiologist concerned with control measures, and as a resourceful, imaginative organizer and administrator, he advanced to the rank of brigadier general in the Medical Corps, and during World War II served as Chief of the Preventive Medicine Service in the Office of The Surgeon General. (Photograph of a portrait of General Simmons, painted by Walmsley Lenhard, in the possession of Mrs. James S. Simmons. Reproduced here with the permission of Mrs. Simmons.)

able at a post in the United States. He was Lt. Col. (later Brig. Gen.) James Stevens Simmons, MC, USA (fig. 39).

In 1936, at the age of 46, Colonel Simmons was at the floodtide of a distinguished Army medical career. During the previous years, he had commanded departmental laboratories, had done important microbiological, clinical, and epidemiological research on infectious disease at the

Army Medical School and in the field, and had been president of Army medical research boards in the Philippines and in the Panama Canal Zone. By reputation and by personal associations he was widely known in the United States. On 28 September 1936, he was brought from Panama by Maj. Gen. Charles R. Reynolds, The Surgeon General (1935–1939), and was assigned to duty as Assistant Surgeon, Headquarters, First Corps Area, at Boston, Massachusetts. General Reynolds had gained a keen appreciation of preventive medicine through his experiences as a Division, Corps, and Army Surgeon, and as Deputy Chief Surgeon, AEF, in France during World War I. He had publicly expressed his belief that *(198)*: "The most valuable contributions of the Medical Department of the Army have been in the field of preventive medicine. The dividends from intelligent service in the future will be no less." General Reynolds was thoroughly familiar with the accomplishents of Colonel Simmons and recognized his potentialities for leadership. It was in the direct course of destiny, therefore, that on 15 February 1940, on orders initiated by General Reynolds, Colonel Simmons *(199)* was "transferred from Boston, Massachusetts, to Washington, D.C., to develop the wartime Preventive Medicine Service in the Office of The Surgeon General, United States Army." He reported for this duty on 24 February 1940, and on this date the revivification of preventive medicine in the Army began. Knowing that evolution is not a completed process but a continuing one, the new chief was prepared and able to direct an ascending evolution of preventive medicine in World War II.

PART X

Epilogue

One of the reviewers of the manuscript of this monograph thought that it would be advisable to end it with a short summarization that would recapitulate the principles of preventive medicine and their advance through the centuries. Although I agreed that it would be nice to close the monograph with a pat epitome, I found it difficult to construct a static abstract of an on-going process. Furthermore, I would regret supplying abbreviated copy to fit the needs of the casual reader, or appear to be conducive to the comfort of those who might prefer to skip the main text. Nevertheless, after many attempts to recapitulate an essay which is already a recapitulation, I offer the following summary and commentary, indicatively, bearing in mind that the period under consideration is only 332 years from 1607, from the founding of the English settlement at Jamestown, Virginia, to 1939, when the United States was preparing for its possible combatant role beside Great Britain in World War II.

In the evolved doctrines and practices of preventive medicine, some of the earliest elements of the remote past are still present. Some of these are vestigial residues, of little use today; but others are as determinative as they were centuries ago, and, indeed, even more influential than ever before because they are now implemented by better technics. Many of the principles and procedures of military preventive medicine were developed by forces and events within the Army. Many others, however, evolved under environmental influences outside the military situation. Military preventive medicine is, in fact, the product of military thought and activities and of the intellectual,

scientific, economic, and political movements and forces in the civilian world. Therefore, the evolution of preventive medicine in the United States Army cannot be considered as an isolated affair. Rather, it is to be regarded and understood as the result of the interaction between civilian and military knowledge and opinion as to what should be done, and how to do it, to preserve the health of soldiers.

The evolution of preventive medicine in the United States Army may be summarized chronologically, episodically, or ideologically. No set of boundaries can prevent penetrations, and the mingling of one set with others is unavoidable because all form a matrix.

The table of contents in this monograph is essentially a chronological summary, because this essay was constructed on a framework of dates and events. Of course, military preventive medicine practiced in the United States Army did not begin with Captain John Smith's squad at Jamestown in 1607. It began before recorded history, probably as soon as a leader took a marauding or defensive band of armed men into campaign. There are plenty of examples of preventive medicine practices in the records of the military forces of ancient China, Egypt, Arabia, Greece and Rome. Some of those practices are principles of today. Cleanliness in posts and camps, disposal of wastes, isolation and quarantine against communicable diseases, avoidance of overcrowding, precautions for drinking water, nutrition, proper clothing, and psychological factors of morale were incorporated in the Mosaic sanitary code in almost modern terms.

No matter what system of divisions and subdivisions is used, it must be borne in mind constantly that there have been actually four major periods in the evolution of preventive medicine in the time span under consideration.

These have been:

1st. The empirical period, 1607–1876.

2d. The period of the Sanitary Reform Movement in Europe and America, centered chiefly in the decades from 1850 to 1890.

3d. The etiological period. "The Bacteriological Era," from 1876 into the present, including the era of viruses.

4th. The epidemiological (statistical) period, from the mid–19th century continuing into the 20th century, concerned with (a) communicable infectious diseases and (b) noncommunicable, noninfectious diseases.

In the following discussion, unequal weights will be given to these various periods, as it is desired in this limited summarization to emphasize a few selected phases.

It is astonishing how many important principles were established in the empirical period. From 1607 until about 1876, the predominant activities in preventive medicine in the Army were the everyday practices, well established by usage, although all sorts of strange notions were given for their justification. From British sources, chiefly the British Surgeons General Pringle and Brocklesby, sanitary knowledge came into the American Colonies and the American military contingents that served in the lines with British forces in severe episodes of European wars that were fought on American soil. In the American Revolutionary War, a German source of preventive medicine doctrine was introduced by Baron von Steuben who, after having served in the armies of Frederick the Great of Prussia, became Inspector General, drillmaster, and disciplinarian of the Continental Army of the United States.

A notable advance over mere empiricism was made in 1721 when Zabdiel Boylston, encouraged by Cotton Mather, inoculated against smallpox (variolation) in Boston. This was the first deliberate experimental immunization, under controlled conditions, in the Colonies—the first positive biological achievement in preventive medicine based upon principles that remain valid to this day. In 1812, a vastly important technical refinement and advance was made when the Army, under a general order of the War Department, was vaccinated against smallpox with Jennerian cowpox matter.

In addition, in the colonial period, the foundation of controlled preventive nutrition was laid by Lind's promo-

tion of the use of citrus fruits and vegetables to prevent and cure scurvy.

For the British training of American physicians and doctors-by-apprenticeship, the 25 years just preceding the outbreak of the American Revolutionary War, the years 1750 to 1775, were of prime importance. A number of men who served in high positions in the Medical Department of the Revolutionary Army were trained in England under Sir John Pringle and under others at universities in Edinburgh and London. Thus, the basic principle that preventive medicine in the army requires a supply of trained personnel went into operation to some extent at an early date.

By the end of the American Revolutionary War and the first years of the republic, nearly all of the modern principles of military preventive medicine, except those which could not be developed before the bacteriological era, were formulated, announced, and sometimes made mandatory by the Commander-in-Chief and even by the Congress. These are listed in condensed form as follows:

1. Responsibility of command for the preservation of the health of troops.
2. Use of medical officers as advisers to line officers.
3. Discipline, general and specific.
4. Personal hygiene; cleanliness.
5. Diet and nutrition.
6. Clothing and shoes.
7. Avoidance insofar as possible of exposure to extreme degrees of heat, cold, and fatigue, and to prolonged wetness.
8. Morale-building; recreational activities.
9. Health education.
10. Immunization (active): inoculation for smallpox.
11. Environmental hygiene:

a. Selection of campsites and shelters with regard to factors affecting health; ground water level, drainage, avoidance of marshes, attention to winds, and ventilation.

b. Avoidance of crowding; floor space.

c. Sanitation of camps; cleanliness.

d. Disposal of excreta and other wastes.

e. Selection and protection of water supplies; purification of water.

12. Reduction of possible disease-transmitting human contacts; isolation of patients and quarantine.

13. Medical intelligence; rudimentary information about disease prevalence in areas occupied or to be occupied by troops.

During the first three-quarters of the 19th century, the chief contributions to military and civilian preventive medicine came from vaccination (Jennerian) against smallpox and from the sanitary reforms and public health movement originating in Europe and England in the early 1800's and extending thereafter to America. Sanitary surveys, the use of disease reporting and of vital statistics, and the development of a more rational and precise epidemiology characterized the period. In the United States Army, Surgeon General Lovell instituted meteorological registers, established climatology, and required carefully detailed surveys of posts and camps. In 1850, Lemuel Shattuck's "Report of the Sanitary Commission of Massachusetts" was the foundation of modern public health in the United States, and the Army derived benefits from the consequences. Lessons were learned from the Mexican War and the Crimean War (especially with regard to Florence Nightingale's establishment of public health nursing). The American Civil War, which started in a morass of disease and poor sanitation, finished by producing some models of sanitary engineering and effective preventive medicine.

Progress, however, did not advance evenly between wars, or even during wars. Between wars, the Army, as usual, was largely demobilized and medical services were so neglected that at the beginning of a new war preventive medicine activities were inadequate and losses by disease were large. This was characteristic of the mobilization before World War II.

Although Pasteur, Koch, Sternberg, and a host of keen

investigators were imaginatively and effectively at work in the field of bacteriology even in the 1860's, and although there were published brilliant speculative essays on the subject of the possible microbial causes of disease, the revolutionizing bacteriological era has been dated arbitrarily only from 1876, when Robert Koch, in Berlin, demonstrated the pathogenic power of the anthrax bacillus. Thereafter, discoveries followed discoveries in quick succession. Bacteria and viruses causing many types of infection were found and studied, and on the basis of new knowledge thus acquired, new measures of preventive medicine, of hitherto unanticipated potency, were devised and applied. The era of scientific military preventive medicine sprang forward, and has been multifariously developed since then.

At the beginning of the 20th century, or shortly before 1900, insect vectors of infectious agents were discovered, and preventive medicine gained new powers. For example, when it was found that mosquitoes transmitted malaria and yellow fever a whole new discipline of preventive entomology was uncovered, and great advances in control measures were made.

After the beginning of the 20th century, the weaponry of preventive medicine was strengthened by the acquisition of new drugs capable of preventing, suppressing and curing certain infectious diseases. Chemotherapy, chemoprophylaxis, and the use of antibiotics began to relegate some of the infectious communicable diseases to minor causes of casualties. Increasingly, support of extensive research and conduct of research on problems of numerous infectious diseases became an essential part of the program of the Preventive Medicine Service of the Office of The Surgeon General of the Army.

Toward the end of the period under consideration, from about 1914 to 1939, interest in the preventive aspects of noninfectious diseases, noncommunicable in the ordinary sense, arose and grew. In this group of diseases, so-called, are psychiatric disorders, mental aberrations, industrial injuries and industrial health hazards, accidents, nutri-

tional deficiencies, and many problems of general hygiene and sanitation. To deal with the problems presented by these and other basically related conditions, a newer type of epidemiology has been developed. In this kind of study, ecological factors of an individual and his total environment are more then ever taken into account, observationally and experimentally.

* * * * *

This exercise in abstracting could be continued at length. I feel, however, that, as this small monograph is in reality a summarization of the evolution of preventive medicine in the United States Army, additional condensation would be superfluous. Sufficient has been written herein to lead expectantly to the sequel in which will be described the application of the old and newer preventive medicine, and the establishment of some new principles, in the global setting of World War II, which should furnish an extended recapitulation under new conditions.

APPENDIX A

HEAD QUARTERS, PEEKS-KILL [1777?]

GENERAL ORDERS

For the ARMY under the Command of
Brigadier General M'DOUGALL.

THE Rank and File of each Company will be equally divided among the Serjeants; who are to take a Roll of their Division or Squad, and be answerable that the Arms and Clothes of the respective Men given to them in Charge, be kept clean and in good Order.

A Copy of the Roll, with the Serjeant's Name, who has Charge of the Men, will be delivered to the Captains, or Commanding Officers of the Companies; and they are to furnish the Field Officers of their Regiments with another Copy of the Roll of the Company, in the Order they receive it from the Serjeants.

The Troops will be regularly messed, Six in each Tent, and the Roll of Duty taken for each Regiment, by beginning with one Man out of each Tent of a Company, then a Second, and a Third, &c. till the Men in each Tent and Company are enrolled in this Order, which will always take them nearly equal out of each Tent, or Mess for Duty, and leave some of their Comrades to take Care of their Clothes, cook their Victuals, and prevent either from being stolen, as well as leave sufficient Room for each Mess, in every Tent.

The Colonel, or Commanding Officer of each Regiment, will order a Copy of this Roll to be delivered to him; the Men paraded by Messes, opposite to their Tents, and cause the Roll of each Company to be called in his Presence, that he maybe certain of these Orders being carried into Execution, which are so advancive of the Service, and the Comfort of the Troops. He shall answer for the Execution of these Orders in his Corps; for no Excuse will be admitted.

INSTRUCTIONS for SOLDIERS in the Service of the UNITED STATES, concerning the Means of preserving HEALTH

Of CLEANLINESS

IT is extremely difficult to persuade Soldiers that *Cleanliness* is absolutely necessary to the Health of an Army. They can hardly believe that in a military State it becomes one of the *Necessaries of Life.* They are either too careless to pay Attention to this Subject, or they deceive themselves by reasoning from Cases, that are by no Means similar. Hitherto they have enjoyed a good State of Health, tho' they paid little or no Attention to such Punctilios; hence they conclude, that, tho' in the Army, they shall continue to enjoy an equal Degree of Health, under the like Degree of Negligence: Such reasoning has proved fatal to thousands. They do not consider the prodigious Difference there is in the Circumstances of five or six People, who live by themselves on a Farm, and of thirty or forty thousand Men, who live together in a Camp. The former chiefly subsist on vegetable Food; they lodge warm and dry, and they breathe in pure Air, which is not contaminated by noxious Vapours: The latter in general subsist too much on animal Food; they sleep frequently on cold and damp Beds, and they breathe foul Air, that is constantly injured by the very Breath of a Multitude; and is frequently rendered much more dangerous by the Stench and Exhalations that arise from putrid Bodies. The Air is injured, as I have just said by the Breath of a Multitude and the perspirable Matter that comes through the Pores of the Skin helps to extend the Disorder. But the Blood and Offals of Cattle that are killed near the Camp, with the different animal Substances that are daily thrown there by the Soldiers themselves, must soon fill the Air with a pestilential Smell, unless they are immediately removed or covered sufficiently deep. When the Soldier pours out Water, in which Flesh has been boiled; when in a peevish Mood he throws away Part of his Ration, because it is too much roasted, or because it is not roasted enough; or even when he throws away Bones that are not well picked; he seldom considers that such Things must soon become putrid, and that he is sowing the Seeds of Disease and Death for himself or his Companions. The Soldier should burn his Meat rather than throw it away: History informs us that great Armies have followed this Rule. Soldiers are not supposed to be acquainted with the Art of preserving Health; they are little versed in Books; but, to the Honour of American Soldiers, it is allowed that no men in Christendom of the same Occupation are so well acquainted with their Bibles: Let them, once more, read the History and Travels of the Children of Israel while they continued in the Wilderness, under the Conduct of Moses; and let

them consider at the same Time that they are reading the History of a great Army, that continued forty Years in their different Camps under the Guidance and Regulations of the wisest General that ever lived, for he was inspired. In the History of these People, the Soldier must admire the singular Attention that was paid to the Rules of Cleanliness. They were obliged to wash their Hands two or three Times a Day. Foul Garments were counted abominable; every Thing that was polluted or dirty was absolutely forbidden; and such Persons as had Sores or Diseases in their Skin were turned out of the Camp*. The utmost Pains were taken to Keep the Air in which they breathed, free from Infection. They were commanded, to have *a Place without the Camp, whither they should go,* and *have a Paddle with which they should dig,* so that *when they went abroad to ease themselves, they might turn back and cover that which came from them*†.

Besides these general Regulations, it is also necessary for the Preservation of Health, that every Soldier be particularly attentive to his own Person. The Straw on which he sleeps should be frequently dried; and he should never spread it on damp Ground, when he can get Hurdles, Bark, Boards, Leaves, or any other dry Substance to put under it. A Soldier should change his Shirt and Stockings once every two or three Days: Though his Stock of Linen is small, a Shirt is soon washed. Little Attention is due to the Colour, provided it be clean. Women are never wanting in a Camp for such Offices. A Man is seldom aware of the Quantity of noxious Matter that comes through his own Skin and is deposited on his Shirt; but if he takes up a Shirt that has been worn a few Days by another Person, he is frequently offended by the disagreeable Smell.

These are some of the reasons why CLEANLINESS of every kind is necessary towards preserving Health in an Army: They are Reasons which every Soldier may understand; but should he neglect to regulate himself accordingly, the Regimental Surgeon will doubtless attend to the Neglect, and his Officers will see that he does his Duty. For every Soldier by his Neglect not only endangers his own Life, but the Lives of his Companions. Nature, or the God of Nature, has commanded, that men who live in Camps should be cleanly: Whoever proves too obstinate, or too slothful to obey this Command, may expect to be punished with Death, or suffer under some dangerous Disease.

W.

**Numb. 5. i.* *†Deut. 23 xii.*

APPENDIX B

ABSTRACT OF REPORT on the Origin and Spread of Typhoid Fever in U.S. Military Camps During the Spanish War of 1898

By

WALTER REED,
Major and Surgeon, U.S. Army,

VICTOR V. VAUGHAN,
Major and Division Surgeon, U.S.V.,

and

EDWARD O. SHAKESPEARE,
Major and Brigade Surgeon, U.S.V.

Washington: Government Printing Office, 1900.

Excerpts from Chapter XV (pp. 194–239), "The Etiology of Typhoid Fever." [Special reference to typhoid carriers.]

Typhoid fever is caused by a specific micro-organism, generally known, from its discoverer, as the Eberth bacillus. This bacterium finds its way with food and drink through the mouth and stomach into the small intestines, where it develops, produces specific lesions, and elaborates chemical poisons which induce the characteristic symptoms of the disease. In addition to its location in the walls of the intestines, this germ is usually found after death from this disease in the mesenteric glands and in the spleen. If proper bacteriological examination be made directly after death, the bacillus is usually found in pure culture in these organs. For this reason the spleen is generally selected for bacteriological study and for the preparation of cultures after death from typhoid fever. However, it seems to be possible for this bacillus to reach any part of the body and to find lodgment in various tissues, having been found in the lungs, liver, kidneys, bones, muscles, and brain. Its lodgment in diverse parts of the body and its long-continued existence in

these localities are accountable for many of the varied sequelae to typhoid fever.

Typhoid fever may run its course and terminate fatally without causing the intestinal ulceration, generally regarded as the specific lesion of this disease. More than 20 cases of death from this disease in which post-mortem examination has failed to show intestinal ulceration have already been recorded, and it is probable that this number will be increased by future observations. It must be evident from the existence of these cases that the bacillus may penetrate the intestinal wall without leaving a marked lesion and that the elaboration of its chemical poisons is not confined to the intestinal tract. It remains for future investigations to determine whether, ordinarily, in this disease the intestinal lesion precedes or follows the infection of the spleen and mesenteric glands. The existence of typhoid fever without intestinal ulceration emphasizes the desirability of a classification of diseases based upon etiology rather than upon pathology. [p. 194]

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The natural distribution of the typhoid bacillus is another subject needing careful investigation. Apparently trustworthy bacteriologists have reported the finding of this micro-organism in the most unexpected places. It has been detected in the soil of localities far removed from the habitations of man and has been isolated from drinking water supposed to be free from contamination. Furthermore, its presence has been reported in the stools of healthy persons as well as in those suffering from dysentery and simple diarrhea. It must remain for future studies to decide upon the reliability of those reported findings and to attach to them their proper significance should they be found to be true.

THE ELIMINATION OF THE BACILLUS FROM THE BODY.

It is important in a study of the etiology of typhoid fever to ascertain by what avenues the specific micro-organism leaves the body of the infected individual. The exhaled air from the lungs of the typhoid-fever subject is germ free, as it probably is in all infectious diseases. There is therefore no possibility of this disease being spread by means of the air exhaled from the lungs. This statement is true only when the exhaled air is free from sputum. In the pneumonias that complicate typhoid fever the Eberth bacillus is found in the diseased lungs and may be eliminated in the matter coughed up and disseminated through the air in the fine spray that accompanies severe fits of coughing. However, the spread of typhoid fever in this manner must be regarded as a bare possibility.

There is no positive evidence that the perspiration from one sick

with typhoid fever contains the specific bacillus of this disease. It is true that this bacterium may be found on the surface of individuals sick with this disease, but in such cases the germ owes its presence in this locality to contamination of the skin with the stools or with the urine. It is possible that under exceptional circumstances this bacillus may find its way to the surface from the blood, as it occurs in the eruptive spots of typhoid fever.

The urine of one sick with typhoid fever may or may not contain the Eberth bacillus. Several observers have found the living virulent bacterium in the urine, especially when this secretion contains albumin. In some of these cases it is more than probable that the germ has found lodgment in the kidney and has produced more or less extensive structural changes in that organ. However, the bacillus may be abundant in the urine when this secretion contains no albumin and when there is no other evidence of structural disease of the kidney. Persons recovering from typhoid fever may continue for weeks to eliminate in the urine millions of the Eberth bacillus. It sometimes happens that a cystitis occurs as a sequel to typhoid fever. In at least some of these cases the inflammation of the bladder is due to infection with the typhoid bacillus, and this germ in a virulent form may after a long time remain in the bladder and render the urine a possible source of the spread of typhoid fever. Houston (British Medical Journal, 1899, vol. 1, p. 78.) has reported a case of cystitis of three years' standing due to the infection of the bladder with the bacillus of Eberth. An interesting point in connection with the report of this case is that the patient never had typhoid fever, but had nursed cases of this disease. Further evidence will be needed before we can accept the possibility of an infection of this kind. However this may be, the occurrence of the specific micro-organism in the urine in cases of typhoid fever is of sufficient frequency to demand that this secretion be disinfected in every case of this disease. Post-typhoidal abscesses may form in various parts of the body and may discharge the Eberth bacillus in virulent form for months and even years. It is unnecessary to add that infected material of this kind should be burned or otherwise disinfected. The necessity for this is evident whether the abscesses be due to the typhoid bacillus or to other bacteria.

The most important avenue for the elimination of the typhoid bacillus from the body is through the bowel. Long before the discovery of the specific micro-organism of this disease man had learned that the stools of typhoid patients contained the infective agent of the disease. It had been frequently observed that epidemics of typhoid fever resulted from the drinking of water contaminated with the stools of those suffering from this disease. The more intelligent members of the medical profession recommended thorough disinfection of the feces long before the bacillus had been dis-

covered. The elimination of the typhoid bacillus in the stools probably begins soon after its introduction through the mouth. Indeed, it is quite certain that an individual may become the bearer and distributor of the infecting agent of typhoid fever without developing the disease himself. The specific bacterium finds its way into the small intestines, in the contents of which it multiplies rapidly, and this intestinal culture may be wholly discharged from the bowels without inducing any local lesions. Furthermore, as we have already seen, typical typhoid fever may develop and death result without intestinal ulceration.

We desire to emphasize the fact that the typhoid bacillus may grow in the intestines of an individual and pass from the same without causing typhoid fever. This is most likely to occur when many irritative saprophytic germs are taken into the alimentary canal along with a few typhoid bacilli. A few hours after infection with such a mixed culture the saprophytic germs may cause a profuse diarrhea, which sweeps from the intestines the typhoid bacilli. This is probably the true explanation of the unquestionable protective effect of diarrheas in certain epidemics of typhoid fever. We shall have occasion to refer to this later. Moreover, it is probable that a considerable proportion of adult individuals are to some extent, at least, immune to typhoid fever. The specific germ of this disease may be transported from one place to another in the intestines of an immune man, and when cast out in the stools may become a source of danger to others. It is probably in some such way as this that epidemics of typhoid fever sometimes appear to originate de novo.

The stools of individuals sick with typhoid fever constitute the most important source for the spread of this disease, and it may be stated in a general way that typhoid fever is due to the transference of some part of the feces of an infected individual to the alimentary canal of one susceptible to this infection. This transference in exceptional cases may be quite direct, as when a careless nurse soils her hands with the dejections from her typhoid-fever patient and eats her food without disinfecting her soiled fingers. Generally, however, the transference is more indirect and the germs in the infected stools may multiply through many generations and be transported by water or otherwise through considerable distances. Moreover, as has been indicated already, the bacilli may pass through an intermediate host, which may be man or one of the lower animals. An immune individual may visit a distant city, the water supply of which is infected with the typhoid bacillus, and he may carry this infection to his village home, where it may be deposited in his normal stool, may find its way into the local water supply, and cause an epidemic of the disease.

Typhoid bacilli are most abundant in the stools of patients suf-

fering from this disease when there is sloughing of the intestinal ulcerations. However, it should be borne in mind that typhoid stools are infectious often before the individual shows any evidence of the disease. In other words, the stool of a man in the incubation period of typhoid fever may be laden with the bacilli of this disease. In this way every latrine in an encampment may be infected with the specific micro-organism of typhoid fever before the disease has developed sufficiently in the individual to be recognized clinically. On the other hand, the stools may continue to be infectious long after convalescence has set in. So great is the danger of the spread of this disease from infected stools that in all cases where fecal matter can not be removed by water carriage, or otherwise, from immediate proximity with human habitation, all stools, those of both sick and well, should be thoroughly disinfected.

Notwithstanding the fact that the typhoid bacillus is abundant in the stools of individuals suffering from this disease, its isolation and identification in the feces is one of the most difficult tasks undertaken by the bacteriologist. This difficulty lies in the separation of the typhoid bacillus from other bacilli, which it resembles in some respects and which are present in the stools in much larger numbers. The colon bacillus, always present both in normal and typhoid stools, grows so abundantly and may resemble the typhoid bacillus so closely that the separation of the two is difficult and often impracticable. It is unfortunate that we have no reliable method of detecting the typhoid bacillus in mixed cultures of this germ and the bacterium coli. Such a method would supply us with a more ready and sure means for the early recognition of typhoid fever than we now possess, and it is to be hoped that future investigations will furnish a practical solution of this question. Many devices dependent upon supposed cultural peculiarities have been proposed and success has been promised many times, but up to the present no reliable, easily applicable method for the detection of the typhoid bacillus in stools has been discovered. [pp. 200–203]

* * * * *

THE DISSEMINATION OF TYPHOID

(a) Transported by man.

Man himself is the most active agent in the dissemination of this disease. He may carry the specific virus in his alimentary canal, on his person, or in his clothing. In this way the germs of the disease may be carried hundreds and thousands of miles and may be widely distributed. An infected recruit may plant the specific bacillus of this disease in every latrine in his regiment before he is suspected of having the disease himself. So widespread is typhoid fever that in assembling a regiment of volunteers it may be as-

sumed that among these men there are one or more infected with this disease. Practically, typhoid fever is always imported into military camps, and having been thus introduced it too frequently finds conditions favorable for its spread. [p. 210]

* * * * *

It is altogether possible for an individual to carry in his alimentary canal and eliminate therefrom the Eberth bacillus in virulent form without having the disease himself. The probabilities are that the majority of men who reach 40 years of age have at some time or another carried this germ in their bodies, and this may account for the fact that men of this age are less susceptible to the disease than younger men. It is also possible in the St. Clair epidemic that the infection came down the river from Port Huron, about 12 miles distant. Another possible explanation might be given by supposing that an individual who had recovered from typhoid fever recently, in visiting one of the houses above the intake discharged from his body into the drains the specific bacillus of typhoid fever. In some instances the typhoid bacillus continues to be eliminated with the urine for several weeks after recovery from this disease, and each cubic centimeter of such urine may contain millions of virulent bacilli. [p. 225]

* * * * *

(e) Transportation of the bacillus on the person or in clothing.

That the infection of typhoid fever is often carried on the hands or in the clothing of nurses and other attendants there can scarcely be any doubt. This is probably one of the chief means by which the disease is spread through a family after its introduction. The mother or other attendant on the sick handles the food of the well without disinfection of the hands. Superficial ablution with soap and water is not sufficient to destroy the vitality of this organism; thorough disinfection, with special attention to the material collected under the finger nails, is absolutely essential. At one of the division hospitals at Camp Alger in August, 1898, the members of this board observed the nurses, many of whom went directly from their duties in the typhoid wards to their mess tents and handled the food eaten by themselves and passed articles to their neighbors without even washing their hands. Another practice for which superior officers were responsible is undoubtedly accountable to a greater or less extent for the spread of typhoid fever among the soldiers at the various encampments in 1898; It was customary in some of the commands to take a fresh detail of men from the line each day as orderlies at the hospital. Each morning 100 men were detailed to attend those sick with typhoid fever, to place and adjust bedpans, and to carry the contents of these to the sinks and to disinfect them. These men, at least the majority of them, were

wholly ignorant of the nature of infection; they had never had any training as nurses; they knew nothing about the desirability or necessity of being careful in order to prevent infecting themselves, and they knew less about means of disinfecting their hands soiled with typhoid discharges. At the close of the day these men were returned to their company tents, and the next morning a new detail of the same number went through with the same routine. A more effective means for the spread of typhoid fever could scarcely have been devised.

Many of the so-called cases of prolonged incubation after exposure to typhoid fever can be best explained by the supposition that the infective material is carried on the person some time before it finds its way into the alimentary canal. We shall have occasion further on to mention some of these cases. However, it may be stated here that undoubtedly a man may carry the typhoid bacillus under his finger nails, in his hair, or on his clothing for weeks, during which time he may travel across the continent, and at last accidentally introduce the germ into his alimentary canal and develop the disease. Some authorities lay much stress upon the period of incubation in the infectious diseases, and the International Sanitary Conference, which has attempted to prevent the spread of the plague from India, has based its most important measures upon what is supposed to be the maximum period of incubation of the disease. It must be evident that we know very little about the true period of incubation in most of the infectious diseases. If a hospital corps man who has been attending typhoid patients at Ponce, Porto Rico, leaves that place on a certain date, does not come in contact with other typhoid patients, and ten weeks later develops the disease, this certainly does not prove that the period of incubation in typhoid fever may be extended to ten weeks. This man may have carried the specific germ on his person or in his clothing for the first eight out of the ten weeks and then accidentally introduced it into his alimentary canal. The fact that a belief in ten days as the maximum period of incubation in the plague has been the cause of the introduction of that disease from India into Europe should cause us to hesitate about laying too much stress upon so-called periods of incubation. The period of incubation of an infectious disease is the time which elapses from the introduction of the germ into the body until the development of the first symptoms of the disease, and unless we know definitely and positively the day or the hour of the introduction of the germ into the body, we can not determine the period of incubation. The number of days, weeks, or months the patient has carried the germ in his clothing has nothing to do with the period of incubation.

Experimental evidence shows that pure cultures of typhoid fever

bacilli will retain their virulence when poured upon cotton, linen, or woolen cloth for from two to three months, and it is altogether possible that the infection may be carried in a blanket roll for a much longer time. The evidence which we will bring forward in connection with the history of typhoid fever in our Army during the late war with Spain will show quite conclusively, we think, that infected clothing, bedding, and tentage had much to do with the spread of typhoid fever and will demonstrate the necessity in attempting to eradicate this disease from an infected command of disinfecting all the above-mentioned articles.

The personal and bed linen of patients sick with typhoid fever when soiled with discharges from the kidneys or bowels should be immediately immersed in a properly prepared disinfecting solution. When such articles are thrown aside without previous disinfection, flies may carry the infection from the stains to articles of food, and, moreover, after the material dries, handling these articles may scatter the infective material through the air in the form of fine dust.

(f) Dissemination by flies.

We are satisfied that the evidence furnished in our studies, to be detailed later, is sufficient to show beyond reasonable doubt that the most active agents in the spread of typhoid fever in many of the encampments in 1898 were flies. [pp. 228–230]

APPENDIX C

Circular No. 5: Yellow Fever Prevention and Control

NOTE.—The first directive for the prevention and control of yellow fever, based upon the findings of the Walter Reed Yellow Fever Commission, was issued as Circular No. 5 by command of Major General Leonard Wood (1860–1927), Governor General of Cuba (Dec. 1899–May 1902), at Havana, Cuba, on 27 April 1901. The text of this document was reproduced in the Annual Report of The Surgeon General of the U.S. Army for the fiscal year ended June 30, 1901. The following are excerpts from that report (various places on pp. 144–146).

REPORT OF MAJ. V. HAVARD, SURGEON, UNITED STATES ARMY, CHIEF SURGEON, DEPARTMENT OF CUBA, July 22, 1901:

I have the honor to submit the following report of the operations of this office for the fiscal year ending June 30, 1901:

* * * * *

In the summer of 1900, on the recommendation of the Surgeon-General, a board of medical officers consisting of Maj. Walter Reed, United States Army, and Contract Surgeons Carroll, Agramonte, and Lazear, United States Army, was convened in Havana for the investigation of tropical diseases. The result of its experiments, as already well known, was one of the most brilliant medical discoveries of the age, namely, the mode of transmission of yellow fever, and, as a natural consequence, a complete revolution in the methods adopted to prevent and combat this disease. The doctrine of the transmission of yellow fever by the bite of mosquitoes having been proved by incontrovertible experiments on nonimmunes and fomites proved to be harmless, the following circular having received the sanction of the Surgeon-General, was published.

CIRCULAR, No. 5

HEADQUARTERS DEPARTMENT OF CUBA,
Habana, April 27, 1901

Upon the recommendation of the chief surgeon of the department, the following instructions are published and will be strictly enforced at all military posts in this department.

The recent experiments made in Habana by the Medical Department of the Army having proved that yellow fever, like malarial

fever, is conveyed chiefly, and probably exclusively, by the bite of infected mosquitoes, important changes in the measures used for the prevention and treatment of this disease have become necessary.

1. In order to prevent the breeding of mosquitoes and protect officers and men against their bites, the provisions of General Orders, No. 6, Department of Cuba, December 21, 1900, shall be carefully carried out, especially during the summer and fall.

2. So far as yellow fever is concerned, infection of a room or building simply means that it contains infected mosquitoes; that is, mosquitoes which have fed on yellow fever patients. Disinfection, therefore, means the employment of measures aimed at the destruction of these mosquitoes. The most effective of these measures is fumigation, either with sulphur, formaldehyde, or insect powder. The fumes of sulphur are the quickest and most effective insecticide, but are otherwise objectionable. Formaldehyde gas is quite effective if the infected rooms are kept closed and sealed for two or three hours. The smoke of insect powder has also been proved very useful; it readily stupifies mosquitoes, which drop to the floor and can then be easily destroyed.

The washing of walls, floors, ceilings, and furniture with disinfectants is unnecessary.

3. As it has been demonstrated that yellow fever can not be conveyed by fomites, such as bedding, clothing, effects, and baggage, they need not be subjected to any special disinfection. Care should be taken, however, not to remove them from the infected rooms until after formaldehyde fumigation, so that they may not harbor infected mosquitoes.

Medical officers taking care of yellow fever patients need not be isolated; they can attend to other patients and associate with non-immunes with perfect safety to the garrison. Nurses and attendants taking care of yellow fever patients shall remain isolated, so as to avoid any possible danger of their conveying mosquitoes from patient to non-immunes.

4. The infection of mosquitoes is most likely to occur during the first two or three days of the disease. Ambulant cases — that is, patients not ill enough to take to their beds and remaining unsuspected and unprotected — are probably those most responsible for the spread of the disease. It is therefore essential that all fever cases should be at once isolated and so protected that no mosquitoes can possibly get access to them until the nature of the fever is positively determined.

Each post shall have a "reception ward" for the admission of all fever cases, and an "isolation ward" for the treatment of cases which prove to be yellow fever. Each ward shall be made mosquito-proof by wire netting over doors and windows, a ceiling of wire

netting at a height of 7 feet above the floor, and mosquito bars over the beds. There should be no place in it where mosquitoes can seek refuge, not readily accessible to the nurse. Both wards can be in the same building, provided they are separated by a mosquito-tight partition.

5. All persons coming from an infected locality to a post shall be kept under careful observation until the completion of five days from the time of possible infection, either in a special detention camp or in their own quarters; in either case their temperature should be taken twice a day during this period of observation so that those who develop yellow fever may be placed under treatment at the very inception of the disease.

6. Malarial fever, like yellow fever, is communicated by mosquito bites and therefore is just as much of an infectious disease and requires the same measures of protection against mosquitoes. On the assumption that mosquitoes remain in the vicinity of their breeding places, or never travel far, the prevalence of malarial fever at a post would indicate want of proper care and diligence on the part of the surgeon and commanding officer in complying with General Orders, No. 6, Department of Cuba, 1900.

7. Surgeons are again reminded of the absolute necessity in all fever cases to keep from the very beginning a complete chart of pulse and temperature, since such a chart is their best guide to a correct diagnosis and the proper treatment.

By command of Major-General Wood:

H. L. SCOTT, *Adjutant-General.*

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(*b*) Preventive Medicine in the American Revolutionary Army, pp. 379–382.

(*c*) Remedial Medicine in the American Revolutionary Army, pp. 450–453.

(*d*) Effect of the American Revolution on American Medicine, pp. 550–553.

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