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THE UNITED STATES ARMY MEDICAL DEPARTMENT AND ITS RELATION TO PUBLIC HEALTH[1]

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MEDICAL CORPS, U. S. ARMY

AN army exists for the purpose of destroying the power of the enemy and preventing his retaliating in kind. The medical department of an army is, as are all branches, charged with doing all possible to bring about this end. Specifically, in the words of our army regulations:

The mission of the Medical Department is the conservation of man power—the preservation of the strength of the military forces. This is accomplished by the selection and enrolment for military service, through properly conducted physical examinations, of only those men physically fit for the performance of the duties to devolve upon them, by keeping such personnel in good physical condition through the application of modern principles of preventive medicine, and in furnishing those who do become disabled with such aid in the form of evacuation and hospitalization facilities as will speedily restore them to health and fighting efficiency.

This is a clear statement of our duty in general terms, and the manner of its performance in modern warfare may be appreciated when I tell you that, in the world war, 85 per cent. of the total number of American army battle casualties were returned to duty, and a total of 95 per cent. of the sick and ordinary injuries were returned to duty. And to those who do not know of the work of the medical service in combat, let me say in passing that though ordinarily considered "non-combatants," the casualties in our

[1] The fourth annual Delta Omega lecture at the Massachusetts Institute of Technology, April 3, 1931. The Delta Omega lecture is delivered each year before the chapters of the Delta Omega Society of the Massachusetts Institute of Technology and of the Harvard School of Public Health, and to it the public is invited. The Delta Omega Society, to which selected students of public health are admitted, was founded in 1924 at the School of Hygiene and Public Health of the Johns Hopkins University. Other chapters have been established at Harvard, the Massachusetts Institute of Technology, Yale, Michigan and California.

department at the front in the great war were second only to those of the Infantry. Just consider that there were, in proportion, more men killed or wounded among the officers and enlisted men of the Medical Department than among those of the Artillery, Air Service, Cavalry, Signal Corps or Engineers who saw front-line service.

I do not propose discussing to-day the work of our corps in its purely military duty. That would be of only secondary interest to you as public health men. Though there can be no really essential difference in the work of the military sanitarian and his civilian confrère, there are certain aspects and limitations of the work of each which I propose to mention. The fear of "state medicine," that bugbear of the general practitioner, has at times led to ill-founded statements and distortion of facts regarding the federal services.

Military sanitation is the prevention of disease in armies. More specifically it consists in the practical application, under diverse conditions met in the field and camp or permanent garrison, of a system of principles relating to the preservation of health. It embraces all the details which relate to public health, in a civil community, and in addition must take cognizance of other factors which either do not enter into or can not be controlled in civil life.

While the civilian health officer has to deal with the population as he finds it, the military sanitarian can choose the bulk of his human material in the form of recruits, the proper selection of the soldier constituting one of the most important requirements for attaining satisfactory health conditions and the greatest degree of military effectiveness. The fundamental reason for military sanitation is not humanitarian, but increased military efficiency and the application of sanitary principles adapted to the requirements of the military machine assist in the struggle for victory.

I do not mean to imply that civilian health officers should not be interested in military sanitation. Quite the contrary. Wars are now waged not by armies alone, but by the entire resources of personnel and matériel of nations. This can not well be otherwise in view of the possibilities of the wars of to-day and to-morrow, and we must face these facts, whether we like them or not. In the broad sense were we to be drawn into a war now, each one of us, including you, would, in a measure, be called upon to practice military sanitation and military preventive medicine, and this holds true whether we have a large army, a small army or no army at all.

In time of peace, a military command living at an army post is composed of individuals, not excepting civilians of all ages, under a much more complete control than is possible outside the service. Obviously the military health officer's work is rendered more simple thereby. He has but one man to convince of the desirability of the step that he recommends, and that man is the commanding officer. The commanding officer is responsible, and, having been convinced, can issue a military order which will be binding upon each and every soul, living upon the post. Civilians not wishing to comply with such orders are not permitted to remain. Of course such a condition requires complete confidence in the health officer, or medical inspector as he is called in the service, on the part of the commanding officer. A commander who does not trust the ability and knowledge of his medical advisers usually is not slow in taking steps to secure their replacement. On the other hand, the military officer of health has special difficulties. His great power is at once a source of weakness. He is immediately blamed for anything that goes wrong in a medical way, and usually he has to carry the responsibility alone. Military personnel are by the very nature of things unable to live in the same way as civilians. There are medical conditions incident to overcrowding, exposure and long hours, problems concerned with the supply of potable and sufficient water in the field, the disposal of body and other wastes when on the march and in camp, venereal infections, and many others, all of which must be considered in a different light from that in which the civilian health officer labors. The recommendations made must be adapted to the necessities in each case.

The greatest of all differences in the recommendations of the military as contrasted with the civil health officer is that of objective. The civil health officer knows no higher law than the preservation of human life and health. Other considerations are secondary. But in the army the military necessity must come first. This is, of course, considerably less so in time of peace than in war, but the difference is always felt. The medical inspector in the army may know that to order soldiers into a certain locality will inevitably result in increased incidence of disease or even loss of life, yet such orders may be necessary and therefore, to a soldier, desirable. A medical officer who merely recommends against such action, relying on the fact that it is not himself but the commander who must bear the responsibility, or who otherwise offers only destructive criticism, is not worthy of his salt. He is, under such circumstances, merely an *objector,* a "no-man," far more deadly than the "yes-man," to use a bit of army slang. So the military officer of health must possess a sufficiently broad knowledge of his subject to be able to offer sound advice in such times of stress or in handicap conditions. A mere recollection of rules of thumb will not suffice him.

With modern advances in preventive medicine and the consequent increasing degree of protection from communicable diseases afforded the children and youth

of the nation, special problems arise for the military health officer. More and more of such children attain adult years without having acquired immunity to certain diseases by having had them, or with low resistance to some of the common communicable diseases. This has an important bearing on mobilizations of troops that may be necessary in the future, as well as in the peace-time problems of army life. Recruits are having a higher and higher group susceptibility not only to those diseases of which one attack confers permanent immunity, but also to those, resistance to which is developed by repeated exposure or attacks.

Entirely aside from all this, military medical officers in their turn must at all times be interested in every means of preserving the health of our whole population and of preventing diseases in general. This phase of our task will be of more interest to you than the other.

"When," as Surgeon-General Ireland says, "the profession of public health has made an advance, the army has advanced with it, and occasionally it has led the profession." Our corps is a small body consisting of less than a thousand medical officers, and as this group has the task of providing medical and surgical attention of every sort to the army and its dependents, at home and abroad, there can be but a comparative few whose duties are spent chiefly in the field of public health and hygiene.

Let me run over some of the work that our officers have done in this field in the past. In other words, let me recall to you some of the contributions to sanitary science of members of the medical department of your army. I limit myself to career medical officers or those whose work has been performed while they were in the service. Otherwise I should merely be reviewing the work of American medical science in general, for in time of war practically the entire medical and public health professions have been and will again be at the service of the government.

Our army medical department has numbered on its rolls not a few of America's foremost men of science. As early as the Revolution, Washington's army included such men as John Morgan and William Shippen, both graduates of Edinburgh and successively directors general of the army. They were leading pioneers in medical education and the principal founders of the medical department of the University of Pennsylvania, the oldest medical school in this country (1765). Associated with them in the Continental Army was an even more distinguished officer, Benjamin Rush, likewise an Edinburgh graduate and sometime physician general of the Middle Department. He succeeded Morgan as professor of practice in the College of Philadelphia, and was the founder of the Philadelphia Dispensary, the first in America (1786). He was the ablest clinician of his time, a signer of the Declaration of Independence, and dubbed by Lettsom the American Sydenham. His monograph on insanity was the only systematic treatise before 1863, and of particular interest to us as public health men is his well-known account of the Philadelphia epidemic of yellow fever to which I shall refer later. He also wrote a valuable pamphlet on the hygiene of troops (1777), and his papers on the American Indian are considered the first American contributions to anthropology.

The earliest American pharmacopoeia was that prepared for the use of the Continental Army by William Brown, of Virginia, who succeeded Rush as physician general of the Middle Department. It appeared in Latin in 1778. The first surgical work published in this country was from the pen of John Jones, a soldier of the French and Indian, and Revolutionary Wars, and as it included an appendix on camp and military hospitals, it must be reckoned the first American book on military medicine.

James Tilton, one of the early surgeons general after the Revolution, introduced the "hut system" during the war to avoid overcrowding of hospitals, a step much in advance of the then prevailing usage in this and other countries.

In 1834, Joseph Lovell, the first surgeon general of the army under the reorganization of 1818, introduced competitive examinations for admission to the Medical Corps, one of the two administrative measures for which he is remembered, the other being the abolition of the whiskey ration—a valuable step, though hardly popular with the general public of those pre-Volsteadian days.

The surgeon general of the army just after the outbreak of the war of 1861 was William Alexander Hammond, who made his mark as a physiologist by his essay on "The Nutritive Value and Physiological Effects of Albumin, Starch and Gum when Singly and Exclusively used as Foods," which won him a European reputation, the medal of the American Medical Association (1853) and the chair of anatomy and physiology at the University of Maryland, in 1860. He continued Tilton's provisions for the prevention of overcrowding by the extensive construction of hospitals upon the pavilion system. And he did more. In the words of another great military medical officer, Weir Mitchell, "he duly saw and grasped a great opportunity, and served his country as few could have done"; he created the Army Medical Museum, now the largest institution of its kind in the world. His systematization of medico-military reports led to the compilation, under his administrative successors, of the extensive "Medical and Surgical History of the War of the Rebellion" (a title that possibly would not

have been chosen to-day), "with the publication of which," said Virchow, "began a new era of military medicine." It was the prototype of the even larger "History of the Medical Department of the U. S. Army in the World War." Another of Hammond's contributions was his cutting of calomel and tartar emetic from the supply table of the army. This may seem a small matter to-day, but not if we recall the once orthodox practice of producing and ascribing wonderful curative properties to mercurial salivation and mild antimonial poisoning. Nor must we suppose that the medical profession received Hammond's action calmly, for a great cry was raised. Under this chief the army planned and adopted the use of ambulances, thereby setting an example for civilian hospitals to follow later.

During the war of 1861 Assistant Surgeon Da Costa first described the irritable heart in soldiers (1862) and Assistant Surgeons S. Weir Mitchell, George R. Morehouse and William W. Keen made their investigations of gunshot and other injuries of nerves (1864) which have become classical. All these men are known to the world as the foremost American physicians and surgeons.

The war of 1861 produced another outstanding medical officer, John Shaw Billings, the father of the Army Medical Library, to be discussed later. Billings was the author of the best history of surgery that has been published in English, the designer of the Johns Hopkins and other modern hospitals and of the New York Public Library—certainly a wonderful contributor to scientific advance. His survey in 1870 of the Marine Hospital Service, then the sport of politicians, initiated the improvements and growth which have resulted in the present splendid U. S. Public Health Service.

One of America's pioneers in bacteriology was Surgeon General George Miller Sternberg, the author of the first manual (1893) and text-book (1896) of bacteriology as well as important treatises on immunity (1895), disinfection (1900) and infection (1903). He was the first to isolate what was then called the bacillus of croupous pneumonia (1880). He also did important work on yellow fever, and under his administration Major Walter Reed carried out his experiments on transmission of that disease, to be mentioned later. Sternberg, after directing the work of his corps through the Spanish-American War, in the face of legislative and administrative obstacles, established the corps of women nurses, organized the medical service of the new tropical possessions and established the Army Medical School. His service to the public health was attested by his having been elected president of the American Public Health Association as well as of the American Medical Association.

The contributions of the members of the Army Medical Corps to advancement of public health since the Spanish-American War are best understood by selecting for discussion the most important diseases of which our knowledge has been advanced by work of army officers.

TYPHOID FEVER

Typhoid fever was ever the curse of armies in the field, and it seems particularly fitting that army medical officers have taken such a prominent part in bringing it under control.

It is hard to ascertain with accuracy the number of cases in this country prior to the war of 1861, and even in that war such terms as "bilious remittent fevers," "typho-malaria," etc., were used to take the sting out of a diagnosis of typhoid fever, though the latter was made official in 1862 and from that time until June 30, 1866, there were 57,400 cases with 5,360 deaths reported under this name.

With the mobilization of troops for the war with Spain in 1898 this same fever spread rapidly through the camps, though reported under a variety of names. More than 20,000 cases of typhoid fever occurred in the military camps in the United States alone. A board of three medical officers was appointed to study the cause of the epidemics. Its members were Major Walter Reed (who while doing graduate work at Johns Hopkins had already made an important contribution to the pathology of the liver in typhoid fever), Major Victor C. Vaughan and Major Edward O. Shakespeare. Their careful investigations showed that more than 90 per cent. of the volunteer regiments developed the disease within eight weeks after going into camp, that typhoid fever is disseminated by the transference of the excreta of infected individuals to the alimentary canals of others, that camp pollution was a more prominent causal agent in this instance than contaminated water supplies, that the disease was largely spread by flies on the clothing and hands of human carriers, etc. In the epidemic of the Spanish-American War the deaths from typhoid fever were 86.24 per cent. of the total deaths, the morbidity from the disease being 151.05 per 1,000 of mean strength, the mortality being 15.82 per 1,000 of mean strength in a force of 107,973 men. A terrible story indeed!

The British were the first to practice immunization against typhoid fever. Sir Almroth Wright, then a professor in the Royal Army Medical College, began in 1896 to practice vaccination against this disease, the procedure being wholly voluntary. Despite Wright's work protective vaccination was not immediately adopted generally in the British service and in the Boer War of 1899–1902 all the mistakes of the American Army during the Spanish-American War

were repeated. Of a total strength of 380,653, there were 57,684 cases and 8,225 deaths, or a morbidity of 151.15 and a mortality rate of 21 per 1,000.

Discouraging reports of a "negative phase," following the inoculation against typhoid and unfortunate accounts of higher mortality amongst vaccinated troops in infected areas than in unvaccinated troops at less infected stations, resulted in the prohibition in 1903 of typhoid vaccination in the British service. Fortunately Wright's procedure was vindicated by the Royal College of Physicians and again put into operation, and, though it was not made compulsory, 82.3 per cent. of British soldiers in India received the treatment in 1910.

Major Frederick F. Russell, of the U. S. Army Medical Corps (a brigadier general of the reserve since his resignation from the regular army, and general director of the International Health Board), studying the results of British practice, began in 1909 the gigantic experiment of vaccinating the U. S. Army against typhoid. From a morbidity of 173 cases in that year he was able to bring the statistics down to nine cases in 1912 with but one fatal case reported. The officers and men who volunteered for his experiments are deserving of the thanks of their countrymen. In 1911 he was able to have vaccination against typhoid fever made compulsory and with the mobilization of our troops on the Mexican border in the following year he had ample opportunity to test results in the field. During this mobilization he vaccinated some 20,000 men against typhoid, and the only case that occurred in camp was that of a non-vaccinated teamster. Ours was the first army to take this step.

Then came the world war. At first the only one of the armies adequately vaccinated was the British. In 1914 alone there were more than 45,000 cases in the French army. In 1915 the rate per 1,000 was four for the British, 18 for the Italian and 10 for the Belgian armies. In this year there were more than 64,000 German and 125,000 Austrian cases (strength not known). And so it went. But the practice of protecting their men against this disease became more and more common until all the armies on both sides required it and in the last year of the conflict no army had a rate as high as one. The following table for the whole period of the war is interesting:

	Rates per 1,000 per annum	
Country	Morbidity	Mortality
France	14.86	1.81
Italy	6.24	.....
Belgium	3.59	0.57
Great Britain	1.02	0.04
United States	0.35	0.05

It has not been possible to obtain the accurate strength returns for the German or the Austro-Hungarian armies, but the absolute number of cases of typhoid fever was 112,364 and 171,601, respectively, both figures being higher than the number of cases in any of the allied armies.

Perhaps the most striking way of setting forth the value of the typhoid prophylaxis is to state that had the rates of the Spanish-American War been in effect at the period of the world war, the United States would have had not 1,572 cases of typhoid fever among its soldiers, but more than a half million.

YELLOW FEVER

In no disease have members of the Medical Corps of our army done more to advance the sum of knowledge and to reduce to its present restricted geographical limits than this terrible malady. Perhaps a better way to put it would be to say that we have the army to thank for our not having the wide spread of "Yellow Jack" that was such a real terror a generation ago. The disease is now all but a medical curiosity.

As early as 1793, Benjamin Rush, physician general of the Middle Department of the army, played an important part in fighting the epidemic of yellow fever in his native Philadelphia, and his account of his work is unapproached for its realism.

In 1820, Surgeon's Mate Merrill, of the 8th Infantry, outlined a new treatment of this disease, which, while perhaps not in keeping with modern clinical methods, at least had the merit of giving great relief to the sufferers in comparison with the extensive venesection and massive doses of purgatives that had been used up to that time.

When Carlos Finlay stated his theory of the insect transmission of yellow fever in 1881, a real step was made, and that great man of science, Surgeon General Sternberg, realizing the desirability of special training in methods of research, sent Major Walter Reed to Johns Hopkins to study pathology under Welch. In 1900 Reed was detailed as the head of what is probably the greatest of all army boards. It was to study yellow fever in Cuba, the disease still being supposed to be caused by the so-called *Bacillus icteroides* of Sanarelli. It may be remarked here that Sternberg's great contribution to our knowledge of yellow fever was his refutation of the mistakes of other workers and the indication that the causative microorganism of yellow fever was not to be found by ordinary bacteriological methods.

The other members of the Reed board were Majors James Carroll, who submitted to inoculation with the disease, Jesse W. Lazear, who died from the effects of an accidental mosquito bite, and lastly Assistant Surgeon Aristides Agramonte, a native of Cuba and at present professor of pathology at the University

of Havana, the only member of the board still living. [Dr. Agramonte has died since this lecture was delivered.]

In 1900, Surgeon Henry R. Carter, of the U. S. Public Health Service, had shown that a period of 12 to 15 days must elapse before a case of yellow fever becomes dangerous to others. This and Finlay's theory were the two principal facts upon which the board had to build. I shall not go into the details of the work of the Reed Commission, for the steps in their experiments are known to every student of bacteriological science. Dr. Turner has set forth the study in an account intelligible and interesting even to the layman. Suffice it to say that they were able soon to dispose of Sanarelli's bacillus (found to be identical with the *Bacillus X* of Sternberg) and proceed to attack the problem of transmission by mosquitoes, realizing also that yellow fever could hardly be a "filth disease," since the cleaning up of Havana by the American administration had not improved the situation in that respect. They showed that under controlled conditions, the bites of *Aedes aegypti* (then called *Stegomyia fasciatus*) caused yellow fever in volunteers; that the much maligned *fomites* had nothing to do with the transmission of the disease; and that the so-called "infected houses" were such solely because they harbored yellow fever mosquitoes.

Comments on the value of the work of Reed and his associates to the world have been many. General Leonard Wood, himself a distinguished officer of the Medical Corps and who while in command in Cuba did much to aid Reed, said:

> I know of no other man of this side of the world who has done so much for humanity as Dr. Reed. His discovery results in the saving of more lives annually than were lost in the Cuban War, and saves the commercial interests of the world a greater financial loss each year than the cost of the Cuban War. In the months when the disease was ordinarily the worst, it was checked and driven from Havana. It was the first time in two hundred years that the city had been rid of it. Hereafter it will never be possible for yellow fever to gain such headway that quarantine will exist from the mouth of the Potomac to the mouth of the Rio Grande. Future generations will appreciate fully the value of Reed's services.

And President Eliot, of Harvard, in admitting Reed to an honorary degree, expressed himself in somewhat the same terms.

In his annual report of 1902, the Secretary of War, Mr. Elihu Root, said with reference to the conquest of yellow fever in Cuba in 1900:

> The brilliant character of this scientific achievement, *its inestimable* value to mankind, the saving of thousands of lives, and the deliverance of the Atlantic seacoast from constant apprehension, demand special recognition from the Government of the United States.

Republics are said to be ungrateful. Certainly they are at times exceedingly slow in recognizing merit. It was not until 1929 that Congress approved an act to present each a gold medal and to publish annually in the Army Register a roll of honor of the names of each member of the Reed Commission and those of the 18 brave men who volunteered for the experiments in the mode of transmission of a disease that was second to none in the terror which it inspired.

The task of eradicating yellow fever from Havana fell to Major William Crawford Gorgas, later surgeon general of the army and the best known man who has held that office. Gorgas was appointed chief sanitary officer of Havana on February 10, 1900. Under General Wood's orders he instituted the measures now practiced everywhere in combating mosquito-borne diseases. He screened yellow fever patients, destroyed mosquitoes, etc., and in three months Havana was freed from the disease for the first time in 150 years.

The success of Gorgas in Havana led naturally to his being put in charge of similar work in the newly acquired Canal Zone in 1904. Here what had been a notorious plague spot of disease, the "White Man's Grave," as it was called, was converted into one of the healthiest communities in existence. Gorgas continued the methods which had proved so successful in Havana. In the face of much stupid opposition at first, Gorgas never hesitated in attaining his objective, that of making the isthmus free from disease before the operations on the canal were commenced. While the elimination of other diseases was no less important than that of yellow fever, this malady comes first in the minds of the general public. Under the French occupation it was a byword that every tile laid on the Panama Railway cost a life. From 1881 to 1889 the French lost more than 22,000 laborers by death, an annual rate of 240 per thousand. One station on the old Panama Railway was called "Matachin," from the Spanish words *matar* (kill) and *Chino* (Chinaman), because 1,000 imported Chinese coolies at this point died off in six months, as did also 1,000 Negroes from the West Coast of Africa.

When the United States took charge of Panama the death rate was 40 per 1,000. A yellow fever epidemic raged from July, 1904, to December, 1905. In less than a year Gorgas had eradicated it entirely and there has not been a single case of the disease there since May, 1906.

In one of his reports Gorgas said:

> When the Canal shall have been finished it can be shown that sanitation cost about $365,000 per year. For

a population of 150,000, this means an expenditure of about one cent per caput per day, and this sum is well within the means of any tropical country.

Elsewhere he says:

I do not believe that posterity will consider the commercial and physical success of the Canal the greatest good it has conferred upon mankind. I hope that as time passes our descendants will see that the greatest good the Canal has brought was the opportunity it gave for demonstration that the white man could live and work in the tropics, and maintain his health at as high a point as he can, doing the same work, in the temperate zone. That this has been demonstrated none can gainsay.

In 1906 during the period of our second intervention in Cuba, Major (now Brigadier General, Ret.) Jefferson R. Kean, a medical officer who had already been commended for his work in helping the Reed Yellow Fever Board, and curiously enough, the first yellow-fever patient that his friend Reed had ever seen, was placed in charge of sanitary affairs in the island by President Taft. This position he held throughout the entire period of occupation, and during this time he extinguished yellow fever, which had reinvaded the island during the first Cuban republic, and owing to the great increase in the non-immune population had spread all over Cuba. In 1900, when yellow fever had been extinguished in Havana, it disappeared from the entire island.

During the remainder of his life, even while he was surgeon general of the army, Gorgas was frequently called to distant parts of the tropical world to give advice and assistance. After his retirement from active duty, after having served as surgeon general through the world war, he was on his way to South Africa for the purpose of taking up yellow-fever work for the International Health Board, when, delayed in Europe by the award of many honors, he died suddenly in London, having been knighted on his deathbed by King George V. As Colonel Ashburn said, "He was a verray parfit gentil knyght."

The preventive measures used by Reed and Gorgas have been, and are being put into effect in many tropical lands. In his recently published report on "Twenty-Five Years of American Medical Activity in the Isthmus of Panama," a work received with enthusiasm in Britain, France and elsewhere, Colonel Weston P. Chamberlain, health officer of the canal, says:

By far the larger part of the morbidity and mortality formerly attributed by tropical *climates* was due, not to climate *per se*, but to isolation, nostalgia, venereal disease, alcoholic excess, poor municipal conditions, and, most important of all, *to infection with specific parasites whose invasion is now entirely preventable.* . . .

Commenting on which, Sir William Horrocks remarks, "This may justly be regarded as a triumph of preventive medicine."

MALARIA

Malaria has always been a disease of the greatest interest to the medical officers of all armies and certainly the greatest advances in our knowledge of the malady have been made by men of that profession. On November 6, 1880, Alphonse Laveran, a medical officer of the French army, discovered the parasite of malaria while serving with the troops in Algeria and in the following year described them in all their aspects. His four great treatises on palludism are classics. In 1897 Sir Ronald Ross, of the Indian Medical Service, then a major, demonstrated the anopheles mosquito as the vector of malaria, discovered the Laveran plasmodia in the stomach wall of anopheles which had fed on the blood of malarial patients, proved that one stage of the parasite is found in the salivary glands of the insect and devised methods of destruction of the insects, which he employed with success in mosquito reduction in Sierra Leone, Lagos, the Gold Coast and Ismailia. Both of these officers were awarded the Nobel Prize and other high recognition of their work.

But it was the Americans who gave the greatest demonstration of anti-malarial work. From 1898 onward our troops were instructed to use mosquito nets and otherwise how to avoid infection—the first army to adopt this measure. The work of Gorgas in Havana was directed mainly to the prevention of mosquito-breeding. During the same period when the yellow fever was being abolished in that city, its malarial incidence was reduced 75 per cent. Later the same administrator obtained the same results in Panama.

Malaria, as we all know, is not as easily eradicated as yellow fever because *Anopheles* (*Anopheles*) is not a domestic insect, as is *Aedes,* and the malarial patient, instead of being capable of giving the infection to the mosquito for three days only, as is the sufferer from yellow fever, is dangerous for weeks, months or even years. Malaria patients are also far more numerous than yellow-fever patients.

But the work goes on and witness the results thus far. In 1901 the incidence of malaria in the U. S. Army was 381 per 1,000; in 1902 it was 272; in 1907, 85; in 1926, eight; and in 1927, six; and for last year it was again six, and this is true even with the increase in malarial incidence following the floods of the Mississippi Valley.

Another medical officer whose work in malariology has been important is Colonel Charles F. Craig, who demonstrated that the intra-corpuscular conjugation

in the malarial plasmodia is the cause of latency and relapse, and of the existence of carriers.

Hookworm Disease

In 1900 Captain (now Colonel) Bailey K. Ashford, U. S. Army, discovered the great prevalence of hookworm disease in Porto Rico, and shortly thereafter it was found to be very prevalent among the rural population of the United States, by Dr. Charles Wardell Stiles, of the U. S. Public Health Service, who described the American hookworm, *Necator americanus*. Ashford devoted himself to the task of stamping out hookworm infection in Porto Rico and in 1903–4 treated some 300,000 patients, reducing the mortality by 90 per cent. This determination of the mode of combatting the long-dreaded "Porto Rico anemia" must be rated as a notable achievement in American hygiene.

Beriberi

When we took possession of the Philippine Islands our medical officers met for the first time the disease beriberi, a peculiar peripheral neuritis all too well known in the East. Many men died of it, particularly in the Bilibid Prison, in Manila and in the newly organized Philippine Scouts. It had been the scourge of the Japanese armed forces, but they had freed their navy from it by changing the rations of the men. In 1909, the U. S. Army Board for the Study of Tropical Diseases recommended that the ration of the Philippine Scouts be changed by the substitution of unmilled for the previously used highly milled rice, a substitution of beans for a part of the rice component of the ration and the prohibition of savings in the meat element of the ration. The admission rate for beriberi as a result fell from 604 in 1909 to 50 in 1910 and two in 1911, and it has been absent, or nearly so, ever since.

Later on, one of the members of the board, Captain (now Colonel) Edward B. Vedder, continued his studies of beriberi, including the infantile form, and his excellent monograph on the subject won him the Cartwright Prize in 1915.

Typhus and Trench Fevers

Typhus Fever: During the great war and the period which followed, American medical officers played an important rôle in campaigns against typhus fever, the age-old scourge of armies. Twice in Serbia, in 1915 and 1919, the epidemics of typhus, the most severe that the world had ever known, were brought under control. Almost as striking results were obtained in Poland.

Trench Fever: The American Red Cross Medical Research Commission showed that this disease, a common cause of non-effectivity in the world war, was due to a filterable virus and transmitted by body lice. The members of the American commission were medical officers of the army under the direction of Major Richard P. Strong, formerly of the regular service, and then a reserve officer.

Malta Fever: In 1898 Lieutenant Walter Cox first described Malta fever in the U. S. Army, and in 1911 Captains (now Lieutenant Colonels) Gentry and Ferenbaugh showed the disease to be endemic in our Southwest.

Physiology of Digestion

"Every physician," says Vaughan, "who prescribes for digestive disorders and every patient who is benefited by such a prescription, owes gratitude to the studies of William Beaumont, who in 1825, on the Island of Mackinac, began his studies of digestion, which he pursued with labor and skill for the benefit of mankind," making what Harvey Cushing calls "the most important contributions to the physiology of digestion made during the century."

Beaumont, a surgeon of the U. S. Army, described his lengthy study of an accidental gastric fistula in the Canadian half-breed, Alexis St. Martin. His "Experiments and Observations on Gastric Juice and the Physiology of Digestion" is a classic known to every student of physiology. He carefully reviewed the work of his predecessors, gave an accurate description of the normal and pathologic appearance of the gastric mucosa in life, the movements of the stomach up to the completion of digestion, showed that the gastric juice is secreted only when food is present and that mechanical irritation of the mucous membrane produces congestion, but only a limited local secretion of gastric juice, thus foreshadowing the work of Pavloff and overthrowing the doctrine of Magendie that gastric secretion is continual. Beaumont's experiments on the effect of gastric juice upon different foods and the relative nutritive values of the latter are in reality the foundation of modern dietetic tables, while his chemical examination of the gastric juice led him to the conclusion that it contains free hydrochloric acid plus some other active chemical substance, proved later by Schwann to be pepsin. The story of Beaumont's efforts to keep in touch with his temperamental patient, his expenditure of his own limited funds in his experiments, and his single-handed work, constitutes one of the most romantic episodes in the history of medical science. Beaumont served through the war of 1812 as a surgeon's mate and later was a surgeon at Fort Mackinac, Michigan, a frontier post frequented by Indians and trappers, where he met his patient, St. Martin. Beaumont General Hospital, U. S. Army, at Fort Bliss, Texas, was named in honor of this great medical officer.

Of Beaumont, Sir William Osler said, "His work

remains a model of patient, persevering investigation, experiment and research, and the highest praise we can give him is to say that he lived up to and fulfilled the ideals with which he set out and which he expressed when he said, 'Truth, like beauty, when unadorned is adorned most, and in prosecuting these experiments and inquiries, I believe I have been guided by its light.'" Osler himself planned to secure St. Martin's stomach for the Army Medical Museum, but when that celebrated patient died in 1880, an old man and the father of 20 children, Osler received a telegram, "Don't come for autopsy; will be killed," and St. Martin's neighbors guarded his grave by night.

Purification of Water

Brigadier General Carl R. Darnall, then a major, devised the first apparatus for the use of chlorine gas in the sterilization of water and was the first to apply liquid chlorine to this use. His priority is attested by basic patents in this as well as other countries, the validity of which has been upheld in the courts. His experimental work was carried out at the Army Medical School, of which he is now the head.

The Darnall filter was an important step in the solution of the problem of supplying potable water to troops in the field. The Lyster bag, devised by Colonel W. J. Lyster, for the chlorination of water in the field by means of calcium hypochlorite, is known to every person who has been in the army since the days of the Texas Border mobilization, and is still the most satisfactory method for this purpose. It is widely used in camps, not merely those of a military nature.

Meteorology

Meteorological data in the United States were first recorded by the medical department of the army in 1814. In 1819 Surgeon-General Lovell directed that the medical officers at each post record weather observations. Beginning with temperature readings only, there were soon added data on rainfall, wind direction, sunshine, cloud formation and precipitation of rain or snow. From these records in later years tables of mean temperature for different localities were prepared, and there followed the construction of weather maps by Espy, which became the forerunners of the Weather Bureau Maps of to-day.

In 1870 Surgeon Albert J. Myer, for whom Fort Myer was named, created the signal corps of the army and became the first chief signal officer. The Signal Corps took over the meteorological records that had been kept by the Medical Department, and continued them until 1890 when the Weather Bureau of the Department of Agriculture was instituted and undertook meteorological work for the country.

Periodic Physical Examinations

The annual physical examinations of army officers, recommended by the Medical Corps and put into effect in December, 1907, by order of President Roosevelt, was the first step towards a measure long practiced in the army and now universally recommended by public health agencies.

Public Health Education

I have already said that the medical department of the University of Pennsylvania, oldest medical school in America, was founded by two medical officers of the army, Morgan and Shippen; so from the first the Medical Corps has been a contributor to the cause of education.

In 1893, without any legal authorization, Surgeon General Sternberg established the Army Medical School, using at first the rooms in the building which then as now houses the Army Medical Museum and Army Medical Library. He detailed the faculty from officers having other duties in Washington, and in his choice of his instructors he, the great bacteriologist, chose wisely. It is not too much to claim that this institution was the first school of hygiene in America.

Later years have fully justified the inception of the school. Though there have been obvious and logical changes in its curriculum and methods of instruction, it has been, in general, used to give special instruction to young physicians just after receiving their commissions in the Medical Corps. For a long time they attended the school on a sort of probationary status (sometimes as contract surgeons, sometimes as officers of the Medical Reserve Corps, etc.) and on satisfactorily completing the course of one academic year, they received commissions as first lieutenants in the Medical Corps of the regular army. More recently an advanced course has been added for officers of field rank. Both courses stress preventive medicine, modern laboratory methods, tropical medicine, hygiene of troops on the march and in the field and the elements of sanitary engineering, that meeting ground of military and civil engineering. In 1923, the new and modern school building was opened at the Army Medical Center in Washington, near Walter Reed General Hospital, and the institution compares favorably with others of its type, such as the Royal Army Medical College at Millbank, London, and the French School of Application at the Val-de-Grâce medical center in Paris.

Shortly after the close of the great war, Congress authorized the army to detail officers, not exceeding 2 per cent. of the total commissioned strength, to scientific institutions of higher learning, for the purpose of pursuing courses of instruction in professional fields that would enable them better to perform the

duties of their grade and corps. The Medical Corps has, under the law, detailed officers of the Massachusetts Institute of Technology and the schools of public health of Johns Hopkins University, Harvard University and the University of Pennsylvania. So far a total of 26 officers have had the benefit of such advanced work, *i.e.*, in public health alone. A fair number of our officers have also completed the course at the London School of Tropical Medicine.

Another post-war development in the education was the Medical Field Service School established at Carlisle Barracks, Pennsylvania, in what had once been the Carlisle Indian School. Here both officers and men are given training in the military duties of medical officers and practical instruction in such subjects as field sanitation, military preventive medicine, sanitary engineering, etc. Here also is a special laboratory for the development of equipment and devices for use of the Medical Department of the army.

In the Philippine Islands there is maintained an important research body—the U. S. Army Medical Research Board. It was established in 1900 at the period just following the Spanish-American War, when the army found itself responsible for the government and health of several tropical dependencies, particularly the Philippines. The high incidence of tropical diseases constituted a menace to the army of occupation and interfered seriously with administration of the newly acquired territory.

The first members of this board were Lieutenants Richard P. Strong (now professor of tropical medicine at Harvard), W. H. Calvert, Assistant Surgeon Joseph J. Curry and Hospital Steward Dr. W. E. Musgrave. They issued in 1901 a valuable outline of the steps that should be taken to prevent the spread of plague, and by means of which the disease was controlled in Manila and kept out of the army. This was before the excellent work of the Indian Plague Commission had demonstrated the agency of the flea in the transmission of the disease.

The work of this board has solved many problems of wide interest in the field of public health. These include important contributions to the sum of our knowledge of cholera, typhoid fever, uncinariasis, yaws, leprosy, epizootic lymphangitis in horses, malaria, filariasis, etc. They showed, for example, that the long-known "hill diarrhoea" was due to the Flexner type of dysentery bacillus. One member (Vedder) demonstrated the amoebicidal action of ipecac (used theretofore empirically), and proved that it was due to the alkaloid emetine. He further showed that this compound is of no value in bacillary dysentery. They showed that diphtheria is far more prevalent in the tropics than had been thought. They pointed out that tuberculosis is two and one half times more common in Filipinos than in Americans. They demonstrated that the horsefly *Tabanus striatus* is the common vector of surra, the most serious disease of horses in the Philippines. An improved vaccine for rinderpest was produced. They proved that canning does not destroy the anti-scorbutic vitamin, a discovery of importance since scurvy was not uncommon. Vedder's work on beriberi has been mentioned.

The board first showed (1925) that the infective virus of dengue is in the circulating blood and that the disease is transmitted by the mosquito *Aedes aegypti*. This was a fitting climax to long work by members of the Medical Corps, begun by Benjamin Rush, who first recognized and described this disease a century ago, and continued since that time by many workers, notably, Colonels Charles F. Craig, Percy M. Ashburn, Joseph F. Siler and others.

In the field of climatology, it was shown that the effect of tropical light on white men is no more deleterious to blondes than to brunettes.

Another important army educational institution is the Army Medical Library. Billings founded what was long called the Library of the Surgeon General's Office, as has been said. This collection of the literature of the medical sciences is one of the greatest in existence. It contains more than a million items, subscribes to some 1,500 journals, and publishes what has been called America's greatest contribution to medicine, *i.e.*, the Index Catalogue of the library and the Index Medicus. The Index Catalogue lists the medical literature of the world as classified and filed in the library. It has completed two alphabetical series and the third series to include the letter P, and thus far embraces 45 volumes of octavo size and about 1,500 pages each. This catalogue is used throughout the civilized world. As a period of 15 to 20 years is necessary for the completion of an alphabetical series, a given subject, for example, typhoid fever, will appear but once in that time. To supplement the catalogue and enable the investigator to locate references to his subject in the current literature, Billings began the Index Medicus, a monthly index of the new medical books and articles appearing throughout the world. Unlike the Index Catalogue, which is a government publication, the Index Medicus never was and it always lost money. The expenses were for a long time defrayed by the Carnegie Institution and it is now continued as the Quarterly Cumulative Index Medicus of the American Medical Association, a necessity as well as a blessing to the medical investigator and writer.

In this library, Colonel Fielding H. Garrison, the best-known American authority on the history of

medicine, has spent his life and done his work. Since his retirement from active service he has been librarian of the Welch Memorial Library at the Johns Hopkins Schools of Medicine and Hygiene.

Unfortunately, the scope of my talk to-day does not permit of a description of Munson's experiments on the footgear of the soldier and his development of the "Munson last" for shoes, now in use in our own and several other armies, of his important work on leadership and his directorship of the morale branch of the general staff during the world war; of Lagarde's valuable work on gunshot wounds in which he disproved the old idea that wounds from bullets are sterile; of Letterman's system of the evacuation of the wounded, a revival of the work of Larrey, surgeon-in-chief of Napoleon's *Grande Armée,* and many others.

One might likewise note the work of distinguished medical officers in other branches of the army. I have already spoken of the creation of the Signal Corps of the Army by Surgeon Albert J. Myer in 1870. Major-General Leonard Wood, a great military leader and chief of staff of the army, was an officer of the Medical Corps, as was also, and at the same time, the adjutant general of the army, Major-General Fred C. Ainsworth, who devised the present system of record keeping. More recently an officer of the Medical Corps, Major General Harry L. Gilchrist, after having distinguished himself in research in his chosen field, was appointed chief of the Chemical Warfare Service. He is a national authority on the effects of chemical agents on animal life and his knowledge is of great benefit to industry as well as in the protection of human life.

It is hoped that I have given the impression that medical officers of our army have by their achievements held their own in comparison with the great medico-military officers of other nations, such as John Hunter, Sir Ronald Ross, Sir William Leishman (sometime director of the British Army Medical Services), von Graefe, Vincent of angina fame (sometime director of the French Army Medical Service), Helmholtz, Cohnheim, Loeffler, von Behring, Laveran, Widal, Pirogoff and others.

I think also that it will have been seen that what our branch of the United States Army has done compares favorably with the so-called "civil" accomplishments of the army as a whole, such as the digging of the Panama Canal, the construction of early railways, the building of the Capitol, Washington's Monument, the Library of Congress, etc., in Washington, the Lewis and Clark Expedition to the Northwest Territory, the expedition of Pike (of Pike's Peak), rivers and harbors work, the conduct of affairs after the San Francisco earthquake and the rest.

Sir Thomas Lewis recently pointed out that not only may medicine be divided into the usual divisions of individual and collective medicine, that is, general practice and public health, but public health itself may be divided into curative preventive medicine or herd treatment, and progressive preventive medicine or herd-pathology. In pure curative medicine the diagnosis is the main end-point whose object is to recognize the known in order to administer the correct established remedy. The worker in pure progressive medicine has no interest in the known except as a starting point to reach out into the unknown. To the scientific investigator the individual, or even the community, is of no importance or interest unless as material to help the progress of scientific medicine. In so far as he is allowed any humanitarian interests at all, the researcher works largely for the future and is glad if during his lifetime any of his work should prove useful in presenting applied medicine with new methods of diagnosis or treatment.

The Medical Corps of the army, as well as some of the other federal departments, offers an exceedingly attractive field to him who has the craving for research, who yet is not sufficiently enthusiastic to slave for the best part of his life in a laboratory in the average research position with its, for shame be it said, comparatively low financial return. Though in the service it is the medical officer's duty to give his first attention to the practice of preventive and curative medicine, he may also find plenty of time and encouragement from those in authority over him to carry on research. The income of the medical officer of the army is not large—I shall tell you in a moment just what it is—but it has one great advantage. It is not liable to be altered or suddenly cut off through the whim of a politician, or the turn of the wheel of chance. It is, as I once heard an old Kentucky judge remark about his salary, which was notably less than he might have earned in the practice of law: "It's not much, but it's awful regular."

The medical officer of the army enters with the grade of first lieutenant. That he does not begin with the lowest grade in the military scale of rank is a recognition of the long period of study that he must spend in preparation. The pay of the first lieutenant, including all allowances, averages approximately $3,100 per year. After three years he is promoted to captain and receives $3,900 per year. After 12 years he becomes major and receives $5,500. In 20 years he is a lieutenant colonel, with a salary of $7,200 and in 26 years as a colonel he receives $8,000. Promotion beyond that rank is by selection.

The medical officer, particularly the medical officer engaged in public health work, is one of the army's

best contacts with the civil community. Balfour says, "If the International Health Board of the Rockefeller Foundation had not the word 'health' in its title, its manifold activities would never have been received with complacency and gratitude by countries not owing allegiance to the Stars and Stripes." That word "health" is a talisman which can successfully unlock many a domestic as well as foreign door. There are occasions when civil authorities do not cooperate in a satisfactory manner with the military, particularly in times and places where there is a real or possible overlapping of authority. But it is hard to imagine a situation in which there is friction between the military and civil officers of health. Indeed, many a wise military commander has, by means of the friendly relations between the medical officers of such commands and their civilian colleagues, brought about a complete understanding and team work with civil authorities.

"The Services," says Dudley, "are the happy hunting ground, and one of the last strongholds of the amateur researcher. The word amateur here is used in its literal sense, not one who does something worse than a professional, but one who does something for the love of doing it. We may only be amusing ourselves, but if something useful emerges from our pastime so much the better, but that is not the main object of amateurs. While we may not wholly agree with the professor who at the end of a lifetime spent on some academic research said, 'Thank God I have never done anything practical,' yet in these sordid times one can not but sympathize with his sentiment."

When the medical officer of to-day thinks of what his predecessors have been able to achieve, of what practical good has come of their experiments, amateurish though they may at times have been, for all have not the facilities of the Army Medical School, the Tropical Board, etc., within reach, of the outcome of patient observation, of the productive results of the application of scientific principles and sound logic he may, with a feeling of pride and hope, continue his task in the realization that his efforts are not only "for the good of the service," to use a military catch-phrase, but likewise for the good of the whole nation.

OBITUARY

RICHARD ALEXANDER FULLERTON PENROSE, JR.

December 17, 1863–July 31, 1931

THE well-traced roots of the Penrose family, one might more accurately say clan, thread their way back to Cornwall before William the Conqueror sought the shores of Britain. For hundreds of years the name of Penrose is intertwined with the activities of that land, and in many instances it stands out conspicuously, whether in the field of knighthood, in law, in diplomacy, in religion, in politics, in education, in commerce or in battle by land or sea. They were also a daring and venturesome people and not at all averse to seeking opportunity in distant lands.

At the seaport of Bristol, in Gloucestershire, England, there lived one Bartholomew Penrose, who with his brother Thomas conducted a ship-building business. Much direct trading with Philadelphia was carried on from this port and it was but natural that stimulating stories of the possibilities of the new land over seas and the great success which was being achieved under the guidance of William Penn should have reached the ears of young Bartholomew and made him eager to go adventuring. About the year 1700 he landed in Philadelphia, and having an excellent social standing and skill in ship-building and sea commerce, he was soon well married and launched on a prosperous career. Thus was the Penrose strain transplanted in Pennsylvania, and whether in public or private life its achievements and rewards in the new world equalled those in the old. High mentality, combined with sound business sense, seems to have been the dominant characteristic of the Penroses wherever they were found and under whatever conditions they lived.

With such a background there came, in the seventh American generation, to Richard Alexander Fullerton Penrose and his wife, Sarah Hannah Boies, at the old homestead, 1331 Spruce Street, Philadelphia, on December 17, 1863, a fourth son, who was named after his father. This boy was richly endowed with the best of the Penrose ancestral traits, and he seemed to have missed out completely in respect to any undesirable qualities which may have existed in his forebears. His was preeminently a scientific mind, and, though engaging in many mining activities which had their roots deep in geology, he never lost his keen and active interest in this department of science. It always occupied the first place in his long and useful scientific life.

He graduated, with highest honors, from Harvard in 1884, and became a member of the Phi Beta Kappa Society. He remained at Harvard for postgraduate work till 1886, receiving the degrees of A.M. and Ph.D. It is noteworthy that his thesis for the latter degree, "The Nature and Origin of Deposits of Phos-