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CONTRIBUTIONS OF THE MEDICAL CORPS OF THE ARMY TO THE PUBLIC HEALTH LABORATORY[1]

By COLONEL EDGAR ERSKINE HUME

MEDICAL CORPS, UNITED STATES ARMY

DR. WILLIAM HENRY WELCH was a long-time friend and constant user of the Army Medical Library. Billings, its great librarian, had selected Welch for his professorship at Johns Hopkins. Not long before his last illness Dr. Welch was in the library and, in the course of one of his delightful conversations, said: "I have been asked on more than one occasion what have been the really great contributions of this country to medical knowledge. I have given the subject some thought and believe that four should be named: (1) The discovery of anesthesia; (2) the discovery of insect transmission of disease; (3) the development of the modern public health laboratory, in all that the term implies; and (4) the Army Medical Library and its Index Catalogue."

"Popsy," as he was affectionately called, was more apt to utter words of wisdom than to write them. The Librarian was so struck by this pronouncement that he reduced it to writing immediately after Dr. Welch had left. I bear witness, for I was the Librarian.

What is "the modern public health laboratory"? I assume that Dr. Welch meant not a mere building with a miscellaneous collection of apparatus, but the concept of the sum of the knowledge of chemical, physical and biological procedures which have added to our scientific knowledge or which aid in the maintenance of health of individuals and communities. In

[1] Presented at the first session of the Laboratory Section of the seventy-first annual meeting of the American Public Health Association, St. Louis, Mo., October 27, 1942.

other words, laboratory techniques of many kinds but all ultimately at the service of the health officer and his associates.

To this concept of a sum of knowledge to-day at the command of those who seek to preserve the nation's health, the Army Medical Department has made great contributions of lasting worth. Many of them are so well appreciated that they hardly require mention. Others are not always known to be contributions by the Army or its officers. To-day, when folk are thinking about their armed forces, it is worth while to review some of these contributions. My list is not an attempt at a complete catalogue. Of course, the Army can only claim credit for the work of its full-time officers or by those whose work was done while in the military service.

America's First Bacteriologist

In any consideration of the contributions of Army medical officers to laboratory procedures, one must immediately think of the great Sternberg, father of American bacteriology. George Miller Sternberg (1838–1915), who was our Surgeon General at the time of the Spanish-American War, is one of America's great scientific figures. Perhaps the best summary of his career is to be found on his monument at Arlington National Cemetery. The text was written by Dr. William Henry Welch:

> Pioneer American Bacteriologist. Distinguished by his studies of the microorganism of pneumonia and scientific investigations of yellow fever, which paved the way for the experimental demonstration of the mode of transmission of that pestilence. Veteran of three wars, brevetted for bravery in action in the Civil War and the Nes Percés War. Served as Surgeon General of the U. S. Army for a period of nine years, including the Spanish-American War. Scientist, author, and philanthropist. M.D., LL.D.

Space precludes a full account of all that Sternberg did in the way of laboratory research, but the great things are so great as to make details unnecessary. He became interested in the new science of bacteriology at its beginning. In 1881 he discovered the pneumococcus, pathogenic agent of lobar pneumonia, which he found constant in his own sputum. It was found to be identical with the organism described by Pasteur in the same year. Later, 1885, Sternberg demonstrated that his *Micrococcus pasteuri* is in fact the capsulated micrococcus found in the rusty sputum of pneumonia patients. While Frankel is entitled to credit for this important discovery, it was Sternberg who first recognized and described the organism.

In 1882, while on duty at Fort Mason, California, Sternberg demonstrated and photographed for the first time the tubercle bacillus, which had been discovered in that year by Koch. Sternberg's photomicrographs of this and other organisms are preserved in the Army Medical Museum. Many of them are unexcelled even by use of the most modern photographic apparatus and lighting devices.

His text-books on bacteriology played a most important part in the development of that science in the United States. In 1880 he translated Antoine Magnin's "Les Bactéries" (1878) from the French. In 1884, under the authorship of both Magnin and Sternberg this work was greatly enlarged and brought down to date. In 1892 there appeared Sternberg's "A Manual of Bacteriology," a milestone indeed. All these works contained many of Sternberg's own photomicrographs as illustrations.

Sternberg must also be remembered for his valuable work on the etiology of yellow fever. Though he did not discover the pathogenic agent, he was able to prove that many supposedly causative organisms were not concerned. The value of this negative work must not be overlooked. Moreover, it was Sternberg who selected Walter Reed for study of pathology of yellow fever in Welch's laboratory at Johns Hopkins. He always gave every support to Reed in his yellow fever work.

Typhoid Fever Prophylaxis

Major Walter Reed (1851–1902) is best remembered for his epidemiological studies which demonstrated that yellow fever is transmitted by the mosquito. His other great contribution to public health is almost as important—the studies of typhoid fever in the Army camps at the time of our War with Spain in 1898, which showed that the disease is transmitted not merely by contaminated drinking water, but by direct contact as well. "Food, fingers, and flies," as Osler put it, or "Dirt, diarrhea, and dinner," as Sedgwick said. Reed's associates in this work were Majors Victor Clarence Vaughan (1851–1929) and Edward Oram Shakespeare (1846–1900).

Typhoid fever is an ancient enemy of soldiers. In all our wars, prior to the first World War, it has taken terrible toll of our fighting men. Between the Spanish and World Wars something happened to reduce this incidence. It was the immunization of troops. Sir Almroth Wright, professor at the Royal Army Medical College, London, had practiced immunization by the inoculation of killed cultures of the typhoid bacillus, but in the South African War there was reported a discouraging "negative phase," so that in 1903 Wright's typhoid prophylaxis was prohibited. It was later again put into use in the British Army, but as a voluntary measure.

The United States Army was first to adopt compulsory typhoid prophylaxis. Surgeon General Robert Maitland O'Reilly (1845–1912) became interested in Wright's work and sent the brilliant Captain Frederick Fuller Russell to Europe to investigate. Russell

was then a professor at our Army Medical School, and to-day, a Brigadier-General, is professor emeritus at Harvard, having been the head of the International Health Board. Russell became convinced of the effectiveness of the practice and in 1909 was given the gigantic task of immunizing the entire United States Army against this disease. From a morbidity of 173 cases in 1909 he brought the number to nine in 1912, the strength of the army remaining about the same. In 1911 the prophylaxis became compulsory. During the mobilization on the Mexican Border, Russell vaccinated some 20,000 men against typhoid, and the only case that occurred in the camps was that of a non-vaccinated teamster.

The World War was the test of the ultimate worth of this measure. Statistics are available, but they may be summed up with the simple statement that, had the rates of the Spanish War period prevailed, we would have had not 1,572 cases of typhoid fever, but half a million!

The corollary of this is the laboratory procedure required for the production of vaccine for this universal military use. It is a huge task. Not only have the Army Medical School Laboratories manufactured all the typhoid vaccine used by our Army, but likewise that for the Navy and the Public Health Service, as well as much for the armed forces of allied nations. At the time of the outbreak of the present war, the Army Medical School was manufacturing more than 2,500 liters of the vaccine per year, enough for a million prophylaxes—an enormous quantity, but even that has had to be exceeded to meet new war needs.

Purification of Drinking Water

No activity of a modern public health laboratory is more important than the examination of water for potability. The work of Army medical officers along this line has been of exceeding importance. It has not been many years since people thought that by taste alone one might judge of the quality of drinking water. But once the danger of water-borne diseases was explained to the public they tended to attribute all intestinal disease to contaminated water.

The proper purification of drinking water therefore became a major problem, and with it the proper technique for laboratory examination of water samples. Filtration was tried at first. The Darnall Filter, devised by Brigadier-General (then Major) Carl Rogers Darnall (1867–1941), was an ingenious adaptation of the principle of mechanical filtration to field needs. Darnall made a far more important contribution to water purification, however. This was the introduction of the use of liquid chlorine for the purpose in 1910. His experimental work, upon which the method is based, was done in the laboratories of the Army Medical School, where he was professor of chemistry and of which he subsequently became the commandant. General Darnall's priority in this use of liquid chlorine is attested by basic patents in this and other countries, the validity of which has been upheld by the courts.

For chlorination of water in the field there have been a number of devices developed in the Army's laboratories. Best known, and still in regular use, is the Lyster Bag, devised by Colonel (then Major) William John L. Lyster. It is a specially woven bag of 30 gallons capacity in which chlorination is effected by the use of calcium hypochlorite. More recently a high-test hypochlorite has been adopted which is more stable and releases a greater amount of chlorine. The Lyster Bag, or modifications thereof, is used in several foreign armies and navies.

Bacteriology of Gunshot Wounds

Prior to important laboratory studies by Colonel Louis Anatole LaGarde (1849–1920) of the Medical Corps, it was commonly supposed that the great heat generated in the firing of a rifle sterilized the bullet. It was, therefore, thought that infections of gunshot wounds were due to contaminations from the clothing, the soil or other means.

Colonel LaGarde doubted this, and by means of a long series of experiments showed that an infected bullet fired from a rifle is still capable of transmitting infection to the tissues into which it strikes. LaGarde's first paper appeared in the *New York Medical Journal,* 1892. In the years following he published a large number of reports of his laboratory studies of the effect of small arms projectiles. Even now, twenty-two years after LaGarde's death, his monograph "Gunshot Injuries" (1914; second edition, 1916) is not outmoded.

More recent laboratory work in the medical side of ballistics was done by Lieutenant-Colonel Calvin Goddard, an honor graduate of the Army Medical School. Goddard is a pioneer in the identification of bullets. By means of twin comparison microscopes he shows whether the same rifle markings are found on an unknown bullet and one fired from the suspected weapon. The medico-legal importance of this work is very great. Goddard also has made extensive studies of powder marks, and other subjects connected with forensic ballistics.

In the laboratories of the Army Medical Museum and in a series of field experiments, Colonel George Russell Callender, assisted by Staff Sergeant R. W. French, has made important contributions to our knowledge of the explosive effect of high velocity projectiles.

WILLIAM BEAUMONT AND THE PHYSIOLOGY OF DIGESTION

The pioneer studies of the physiology of digestion made by Surgeon William Beaumont (1785–1853) of the Army may, at first sight, not be considered contributions to the public health laboratory. Yet they, in fact, are. Though Beaumont did his work far from the centers of medical science and in primitive cabins and tents, it was really research of the first magnitude. As already said, it is not the building that makes the laboratory.

Beaumont is one of the best known of Army medical officers because his courage and skill have somehow caught the popular imagination. Recently a painting by Dean Cornwell has depicted his sitting by the bedside of his famous patient, Alexis St. Martin, a Canadian half-breed Indian.

St. Martin was accidentally shot in 1822, a gastric fistula resulting. This never healed, so that Beaumont, under whose care the patient came, had an unusual opportunity to study the physiology of digestion at first hand. The story of Beaumont's contract with the temperamental St. Martin is one of the thrillers of medical history. The patient, for all that he was receiving a regular salary from Beaumont's slender army pay, had a way of running away, only to be discovered by the energetic and patient Beaumont, so that the studies would be resumed. Beaumont's account of his work is found in his "Experiments and Observations on the Gastric Juice, and the Physiology of Digestion" (1883). "To the bibliographer," said Osler, "there are few more treasured Americana than the brown-backed, poorly printed octavo volume of 280 pages." The pioneer physiologist of the United States, and the first to make a contribution of enduring value, his work remains a model of patient, persevering research.

When Beaumont's famous patient died in 1880, at an advanced age and the father of twenty children, Osler tried to obtain his stomach for the Army Medical Museum. But there came a telegram of warning—"Don't come for autopsy: will be killed"—and St. Martin's neighbors guarded his grave by night.

MALARIA

Malaria is a disease of the utmost interest to armies. It is perhaps the most important single cause of disability in the tropics, where our army and so many other military forces are engaged. It is interesting that the important researches as to the cause of malaria and its mode of transmission have been made by military surgeons. In 1880 Charles-Louis-Alphonse Laveran (1845–1922), a surgeon in the French Army, discovered the parasite of malaria while serving in Algeria. In the following year he described the parasites in all their aspects. In 1897 Sir Ronald Ross (1857–1932), then a Major of the Indian Medical Service, demonstrated the mosquito as the vector of malaria. On these discoveries our war on malaria is based.

The United States Army was the first to undertake anti-malarial work on a large scale. From 1898 onward our troops were given mosquito nets, on the recommendation of Major (now Brigadier-General) Jefferson Randolph Kean, and instructed in their proper use. The work of Gorgas in Cuba and later in Panama in the eradication of mosquitoes, malarial as well as those of yellow fever, is known to all and sundry.

Colonel Charles Franklin Craig first demonstrated the intracorpuscular conjugation of malarial plasmodia as the cause of latency and relapses, and of the existence of carriers.

While the extensive and efficient anti-malarial work done by the Army in the field is hardly to be called a contribution to the public health laboratory, yet much of it rests on proper laboratory identification of mosquitoes, as well as the malarial parasites themselves. Even in the present war our officers in the West Indies, under the direction of Colonel Leon Alexander Fox, have found that *Anopheles bellator,* a mosquito not hitherto incriminated, is a vector of malaria.

VENEREAL DISEASE CONTROL

The laboratory side of the Army's relentless war against venereal diseases came long after many other modes of attack had been used. The chemical laboratory has developed chemical prophylaxis for use in preventing venereal infection. This was not introduced by American medical officers, but the work of Metchnikoff and others was confirmed here, and it was the United States Army which first used this measure on a wide scale. Much research has been done in the way of searching for better chemical agents than the colloidal silver solution and the calomel ointment, and perhaps such will be successful. In the meantime, credit is due at least for effort and for disproving extravagant claims made for certain chemicals and various proprietary products.

In the serodiagnosis of syphilis the Army has done much. Wassermann's test was early tried, and the Army was among the first to require serological examinations in suspected cases of syphilis. Colonel Charles Franklin Craig has done outstanding work in this phase of serology. His monograph "The Wassermann Test" (1918) is authoritative and of lasting value.

The Kahn test for syphilis, now used in the Army together with the Wassermann test, and used in the Navy exclusively in the diagnosis of syphilis, is the

outcome of work done by Major Reuben Leon Kahn of the Sanitary Corps (Army Reserve). Though the Army can not claim any share in Major Kahn's valuable work in the development of the test that bears his name, it can take pride in its support of the work. Major Kahn for many years used to be placed on active duty as a reserve officer, in the laboratories of the Army Medical School, where studies were conducted as to the use of this test in the military service, including service in the field.

One of the first American physicians to use Salvarsan when that product, still known as "606," was brought out by Professor Paul Ehrlich, was Captain (later Colonel) Henry James Nichols. He collaborated with Ehrlich in giving practical tests of the drug in the early stages of its investigation (1910). With Craig, Nichols did a series of researches on the effect of the administration of salvarsan on complement fixation tests for syphilis.

Laboratory Work in Puerto Rico Leads to Successful War on Hookworm

In 1899 Colonel (then First Lieutenant) Bailey Kelly Ashford (1873–1934) began his laboratory studies of what was known as Porto Rican anemia or tropical chlorosis. The cause was unknown, but Ashford soon showed that it was the New World type of hookworm, *Necator americanus*. His account, in his breezy style, of his finding laboratory evidence of infestation by this helminth is interesting:

> Who had ever heard of a whole agricultural class dying of an epidemic of pernicious anemia? It was unthinkable. Hold on! Look at those eosinophiles. What are they doing so numerous in pernicious anemia? . . . Oh, yes, now I remember something I read out of a journal not long ago. A man by the name of Brown found these prominent strawberry looking eosinophiles to be increased in an infection by the worm causing pork measles. Maybe these animals have worms! And I began to laugh; but I sat up far into the night until the chilly morning land breeze began to blow. And I went to bed still intrigued with eosinophiles shooting like comets before my eyes. The idea that a frightful epidemic anemia with a high death rate might be caused by anything so commonplace as worms![2]

As a result of Ashford's findings and recommendations a campaign was begun in our newly acquired island of Puerto Rico, and the inhabitants by tens of thousands were successfully treated. Ashford's work has been duplicated in many parts of the tropical world.

Dysentery

The contributions to our knowledge of both amebic and bacillary dysentery made by Army medical officers have been many and important. As early as 1900 Acting Assistant Surgeon (now Colonel, retired) Charles Franklin Craig was writing on his laboratory and other studies of amebic dysentery as observed in the military hospital in San Francisco. Work on both forms of dysentery was begun about the same time in the Philippines by Assistant Surgeon (later Colonel) Richard Pearson Strong and Dr. William Everett Musgrave, hospital steward. One of the several types of dysentery bacillus bears the name of Colonel Strong, who isolated it in the Army's laboratory in Manila.

Colonel Craig in 1916 found that an epidemic of amebic dysentery among troops on the Mexican Border was fly-borne. This officer's monographs on amebic dysentery contain important reports of laboratory work. "The Parasitic Amœbæ of Man" (1911) and "Amebiasis and Amebic Dysentery" (1935) are valuable reference texts.

Pneumonia

Studies of pneumonia have been of interest to Army medical officers for many years. The discovery of the pneumococcus by Surgeon General Sternberg has already been mentioned. The monumental "Medical and Surgical History of the War of the 'Rebellion'" (6 volumes totaling 4,846 pages) and "The Medical Department of the United States Army in the World War" (17 volumes, totaling 160,291 pages) contain much on laboratory studies of pneumonia. In both works one finds that the Army was at the forefront of medical advance.

In 1917, at the time of the mobilization on the Mexican Border, Major (then Colonel) Henry James Nichols (1877–1927) showed by his laboratory work that the disease was principally due to Type I and Type II of the causative organism.

Since 1933 the Army has been producing pneumonia vaccine in the laboratories of the Army Medical School. It has been distributed to various governmental and other agencies for trial. Reports, though not final, are most encouraging. Pneumonia prevention by the use of Felton's polysaccharide derivative of the pneumococcus, containing a soluble substance, was begun by the Army in 1934. It was extensively tried in the Civilian Conservation Corps camps. Final data for the present war period are not yet available.

Trench Fever

In the first World War it was found that there was present an acute communicable disease, not unlike but distinct from typhus fever. Our British allies gave it the name "Trench Fever." It was found to be louse-borne. The most important studies of this "new" malady were made by the Medical Research Committee headed by the veteran scientist, Colonel

[2] "A Soldier in Science," 42–43.

Richard Pearson Strong, formerly of the Regular Army but then professor of tropical medicine at Harvard. Strong and his associates showed that the filterable infective agent is present in the blood plasma. The disease was reproduced by injections of the blood of patients, either intravenously or intramuscularly.

The U. S. Army Board for Study of Tropical Diseases

In considering the Army's contribution to the public health laboratory one is apt first to think of the Tropical Board, as it is known in the service. Some of its work is mentioned elsewhere in these notes.

With the acquisition of tropical possessions after the Spanish-American War, our Army fell heir to a new category of medical problems. Theretofore we had seen tropical diseases only in a few regions in our far South and never to the extent found in the true tropics. Surgeon General Sternberg, with his usual vision, created in 1900 the *Board for the Study of Tropical Diseases,* the work of which was done in Manila. The members of this first Board were First Lieutenant (later Colonel) Jere Black Clayton, First Lieutenant (later Colonel) Richard Pearson Strong, Acting Assistant Surgeon William Jephtha Calvert, Acting Assistant Surgeon Joseph J. Curry and Hospital Steward Dr. William Everett Musgrave. By means of laboratory research this board contributed largely to the sum of knowledge of plague, cholera, filariasis, dysentery, typhoid fever, blackwater fever, surra, smallpox and other maladies. In 1906 the members of the board were Captain Percy Moreau Ashburn and First Lieutenant Charles Franklin Craig, both later Colonels. They worked on filariasis, dengue, tsutsugamushi fever and intestinal parasitic infections.

As the years went by, the board, with various interruptions, because of what we call "the exigencies of the service," continued its work. In 1909, upon the recommendation of two of its members, Captain (now Colonel, retired) James Matthew Phalen and Captain (later Colonel) Henry James Nichols, the diet of Filipino scouts was changed, with a reduction of beriberi. Beri-beri was long the subject of consideration by the board. In 1913 Colonel Edward Bright Vedder published his valuable monograph on this disease.

In 1910 Colonel (then Major) Eugene Randolph Whitmore established the Pasteur Institute in Manila.

There is not space to consider all the diseases studied in the laboratories of the Tropical Board, many of which were little known in the continental United States, including paragonomiasis, schistosomiasis, filariasis, amebiasis, oidiomycosis, yaws, blastomycosis, sprue, aihnum, cholera, trypanosomiasis and bacillary dysentery. The board also considered certain diseases well enough known at home but which manifested other forms in the tropics, such as uncineriasis, tuberculosis and typhoid fever.

More recent members of the board, such as Colonels George Russell Callender and James Stevens Simmons, have done much valuable work in laboratory studies of tuberculosis, malaria and other diseases. Surgeon General Robert Urie Patterson removed the board from the Philippines to the Canal Zone.

Meleney has called the first two decades of the present century "The Golden Age of Tropical Medicine in the United States," for then yellow fever, malaria, hookworm infection, typhoid fever and the dysenteries were largely brought under control. Certainly the laboratories of our Army medical officers brought forth many of the discoveries to this end. They must ever be considered as leaders among our "Ambassadors in White," to use Morrow's term.

Roentgenology

Since the x-ray is an important laboratory aid to medicine and since its use has certainly resulted in improving the health of the public, it is not out of place to consider pioneer work done by the Army in this connection.

Our medical officers became interested in the new diagnostic aid immediately after Roentgen's discovery in 1895. Apparatus of various types was placed in use during our war with Spain, being chiefly employed in locating bullets. The Army was the first American group to use the x-ray on a large scale.

Alas, the Army had its martyrs to this new science, as did others. Mrs. Elizabeth Fleischmann Ascheim (1859–1905), though not a nurse, was a pioneer in roentgenological work and carried on her studies at the Presidio Division Hospital of San Francisco (now known as the Letterman General Hospital). Working without protection she fell a victim to cancer. One of our officers, Lieutenant Colonel Eugene Garland Northington (1880–1933), likewise lost his life in this way. His arms were amputated, one after the other, but even when entirely helpless, he retained his courage to the end, amid the suffering that goes with such a tragic fate.

Laboratories of the Army Medical Museum

The Army Medical Museum of Washington is not merely a place where unusual objects of medical interest are preserved and displayed. It is much more than a museum, being one of the country's important research institutions. It is the largest medical museum in America and probably in the world.

Much valuable research in pathology, bacteriology, helminthology, entomology and other sciences related to public health and preventive medicine has been

done in this great institution. The building was erected in 1887 and served for a time, not only for the Army Medical Museum and its sister the Army Medical Library, but also for the Army Medical School, when it was first established. In a small annex there are a series of rooms originally built for the bacteriological laboratories of Major Walter Reed. In the early days of bacteriology it was considered dangerous for a bacteriological laboratory to be too near to other buildings! There was still something of the old concept of infection flying through the air from the sick to the well, particularly when wafted by a malevolent breeze. These historical rooms are now used as offices by the museum.

A number of the more important clinical societies of this country place their entire pathological collections in the Army Medical Museum for safekeeping, display and study. Thus the museum has become the central point for the exchange of information and ideas. The Curator of the museum regards this as the institution's most important present function. The institutions which have thus far established Registries, as they are known, in the Army Medical Museum, are the American Academy of Ophthalmology, the American Academy of Oto-Rhino-Laryngology, the American Dental Association, the American Society of Clinical Pathologists, the American Association for Thoracic Surgery, the American Association of Pathologists and Bacteriologists, the American Urological Association and the American Academy of Dermatology and Syphilology. Here are a series of unrivaled collections of pathological material, both gross and microscopic, available to physicians everywhere.

The Army Medical Museum has, among other duties, that of making gross and histological studies of material sent for diagnosis from all stations throughout the army. When a piece of tissue, removed at biopsy, is sent to the museum for study to determine malignancy, reports are sent, where necessary, by telegraph. The museum is also prepared to aid in the identification of insects, snakes, etc. Through close cooperation with other federal agencies the museum's sphere of usefulness is widened

Laboratories of the Army Medical School

One of the most important features of the Army Medical School is its laboratories. There are excellent facilities for chemical, serological, bacteriological and other research, as well as arrangements for laboratory aids in diagnosis. Many of the Army's most important researches have been conducted here.

Elsewhere mention has been made of the preparation of vaccines at the Army Medical School. As a training center it is an indispensable cog in the machine which turns out trained medico-military personnel for the military service. Not for nothing did Professor Welch call the Army Medical School "America's oldest school of preventive medicine."

The Medical Department Equipment Laboratory

At Carlisle Barracks, Pennsylvania, in close cooperation with the Medical Field Service School, the Army maintains a laboratory for the development and testing of equipment for use by the Medical Department in the field. Many of the pieces of apparatus now in common use grew from experimental models made at this laboratory. The range of material considered is the widest. From the latest types of ambulances to new first-aid packets to be carried by the individual soldier, material has been brought out. This may not be a laboratory in the sense in which the term is used by the chemist or the bacteriologist, but it is a laboratory nevertheless, and an efficient one as well.

Aviation Medicine Laboratories

Since most aviation accidents are due to the faults of the pilot rather than the faults of the aeroplane, anything that serves to remove the chance of unfit men attempting to pilot aircraft, must be reckoned a measure of preventive medicine. Special laboratories for the study of the physiology of altitude flying and other phases of aviation have been maintained by the Army Medical Department since the first World War. Much good has resulted.

The work of such laboratories consists of research, and likewise in the training of the men who have the duty of examining flyers. Some men are physically incapable of ever becoming pilots. Others are good pilots at times only. No man is at his maximum physical efficiency all the time. The flight surgeon has the task of being sure that only physically fit men are allowed to fly.

Research on Warfare Chemical Agents

The Medical Department of the Army has nothing to do with the infliction of wounds or death, but must know how such things are brought about. Research, therefore, pertaining to the effects of warfare gases on the human or animal body is of paramount importance.

Work of this nature began with the first World War. Then defensive measures were entrusted to our branch of the military service. Through that war and in the two decades that intervened before the outbreak of the present conflict, specially qualified medical officers have devoted much time and thought to studies of warfare chemical agents.

At our Chemical Warfare School at Edgewood

Arsenal, Maryland, we have a Medical Laboratory. Therein are conducted experiments on the effect of the many kinds of warfare gases and other chemicals on the individuals and on large groups of human beings. The studies include pathology of warfare chemical wounds, chemical means of neutralizing warfare agents and the efficacy of the several types of gas masks.

Obviously work of this kind must, from its very nature, be highly confidential in times like these, but I do not exaggerate when I say that the things that our research men are doing are quite in keeping with the discoveries and advances made in other fields of scientific work.

Dental Focal Infection

It was one of the greatest military surgeons, Surgeon General Benjamin Rush (1745–1813), Signer of the Declaration of Independence, who first suggested that infected teeth might be the cause of disease. In working on problems pertaining to this, our Medical Corps and Dental Corps have worked in close cooperation.

Major Fernando Emilio Rodriguez (1882–1932), Dental Corps, and American officer born in Puerto Rico, may be regarded as the greatest contributor to dental bacteriology since Müller, the German investigator of half a century ago. His researches as to the cause of dental caries began in 1921. By the development of a special technique he was able, at the laboratories of the Army Medical School, to isolate and classify a high acid-producing group of bacteria, *Lactobacillus odentolyticus,* which he classified morphologically as Types I, II and III. He demonstrated Type III as the primary etiological agent in enamel decay, identifying the organism with the flora of the dentinal tubules in caries.

Veterinary Research

The Veterinary Corps is one of the several corps of the Medical Department of the United States Army. Medically important are certain researches by its officers, particularly its present chief, Brigadier-General Ray Alexander Kelser, into those diseases of animals which may be communicated to man.

Kelser demonstrated the transmission of equine encephalomyelitis by mosquitoes, ten species of *Aedes* already having been shown capable of such transmission. Several thousand cases occurred last year in human beings in Minnesota, the Dakotas and adjacent parts of Canada.

Kelser, a member of the Tropical Board, did important work in developing a vaccine for use against Rinderpest, long a serious disease among cattle in the Philippines. This officer also proved the supposition of Mitzmain, that *Tabanus striatus* is the vector of surra, a uniformly fatal equine disease in the Islands. A rabies vaccine, in which the virus is inactivated by chloroform, has been introduced by Kelser and has been found to be more effective than vaccine made by other methods.

Conclusion

These, then, are some of the contributions made by medical officers of your army to the mass of scientific knowledge ever available to the public health worker in his war on disease. Many others could be mentioned, but these will suffice to remind you that while our medical officers have always performed the duties expected of them in the military service they have likewise found time to do much scientific work of general value. To do this our men have had to be willing to work through long hours and to do things not required of them as mere routine. They have done so willingly and gladly, always remembering that whatever they could learn for the good of humanity was entirely in keeping with their prime military function of conserving the fighting strength of America's soldiers.

THOMAS JEFFERSON, THE SCIENTIST

By FREDERICK E. BRASCH

LIBRARY OF CONGRESS

Thomas Jefferson probably had the most forward-looking mind of his day in America. No other American of his generation so deserves to be termed pioneer, prophet and man of the age. His advocacy of democracy, education, religious toleration and the application of scientific knowledge to the common pursuits of life place him far in advance of his day. No contemporary of his, with possibly one exception, Benjamin Franklin, had so varied an interest in the pursuit of science as Jefferson. And yet, no satisfactory or full story of this interest and accomplishments has been published. There is a wealth of material available and it is therefore one proper function of this Bicentenary to reveal and evaluate Jefferson as a man of science.

Much evidence remains of his broad and analytical interest in matters of scientific import. To mention those of more lasting value, several of the various federal scientific bureaus of the United States are the direct result of Jefferson's farsightedness. Some of these bureaus had their origin while he was Secretary of State. The National Bureau of Standards is one, the germ of which originated in an elaborate report of Jefferson dated July 4, 1790, and presented to Con-