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THE DEVELOPMENT OF MILITARY MEDICINE¹

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The subject for discussion is so extensive that it will be possible to cover only some of its more important phases in the limited time available.

I have attempted, therefore, to select what appeared to be not only important but also more or less interesting phases in the development of military medicine, extending from remote times up to and including the modern organization for the selection, protection, evacuation and treatment of military personnel.

Naturally, this development has paralleled more or less closely the development of civil medicine, for both are founded on the same basic principles.

In prehistoric times armies did not exist. Conflicts were numerous but they were of a personal character rather than between groups and were either hand-to-hand combats between individuals or between man and one of the lower animals. No

¹ In preparing this article, the writer has drawn freely from Garrison's "Notes on the History of Military Medicine" and has also received valuable assistance from Colonel Edwin P. Wolfe, M.C., U. S. Army, and Captain N. S. Jarvis, M.C., U. S. A., Ret. Acknowledgment is made of their valuable assistance.

organization existed for the relief of those who were injured and it was a case of every individual looking out for himself as best he could—a real application of the principle of the survival of the fittest.

As time passed we can easily visualize that man began to realize the value of grouping together, first perhaps in pairs and later in larger numbers bound together by the necessity for protection against marauders as well as by a realization of their increased efficiency in hunting animals for food and clothing.

From this we can further visualize the development of these groups into villages, the grouping of villages into larger units and finally the formation of states. This took centuries of time, and with it there grew slowly the realization in the minds of men that they owed something to their fellow men in the group as well as the realization amongst the leaders that such attention enormously increased the morale of their subjects and therefore their fighting efficiency.

Passing over without further comment these very early days, let us consider very briefly some of the methods in vogue during later periods of which we have more or less accurate records.

Egypt

In Egypt warfare by means of organized armies was well advanced. Egyptian civilization was highly specialized and much like our own in many respects. In this connection it is interesting to note some of the exhibits listed in Sudhoff's Dresden Catalogue—baking bread; a market with separate stands for fish, vegetables, etc.; brewing beer; making fire with bellows; people in bed; cosmetics, toilet articles and vanity sets; a barber clipping hair; razors; a bath-room; accouchement of queen by four midwives; wrestling matches; secretaries taking dictation; and (220 B. C.) complaint of a Greek lady to Ptolemy on being parboiled in a public steam bath.

Of their medical service in campaign, Diodorus Siculus relates (i, 82): "On campaigns or other expeditions out of the country, the sick are treated without cost to themselves; for the physicians receive compensation from the state and practice medicine from a formulary compiled by many learned hands. If, following the

prescriptions of this sacred book (Embre), they fail to save the patient, they are absolved from all guilt; but if they run counter to its directions, they are put to death; for the lawgiver opined that few physicians are more competent than a system tested by time and compiled by the best."

As to the organization of the medical profession in Egypt, Herodotus says: "The art of medicine is thus divided among them; each physician applies himself to one disease only, and not more. All places abound in physicians; some are for the eyes, others for the head, others for the teeth, others for the parts about the belly, and others for internal disorders" (ii, 84). Thus we see that specialism, which we are wont to look upon as a modern development, is really hoary with age.

As to their practice of surgery, Larrey, in his *Memoirs*, states that the mural paintings and bas-reliefs in the temples at Karnak, Luxor, etc., afford abundant evidence of the methodical practice of surgery by the ancient Egyptians.² It was, however, essentially external and rudimentary; their knowledge of anatomy was small. The mummies excavated in Nubia in 1907, prior to the flooding of the Assuan Dam, show splinting of fractures by means of palm-fibre bandages, with surprisingly good results and little shortening.

Assyro-Babylonian Civilization

The essential features of Assyro-Babylonian medicine were a demon for every disease, prognosis by liver inspection, and therapy by exorcism and herbal remedies. Conjurations against mosquitoes have been found, and the symbol of Nergal, the Mesopotamian god of disease and death, is a fly. Herodotus (1; 80) describes the ancient Babylonian custom of communal medicine thus: "They bring out their sick to the market place, for they have no physicians. Then those who pass by the sick person confer with him about the disease, to discover whether they have themselves been afflicted with the same disease as the sick person, or have seen others so afflicted; thus the passers-by confer with him, and advise him to have recourse to the same treatment as that by which they escaped a similar disease, or as they have

² D. J. Larrey: *Memoires de Chirurgie Militaire*. Paris, 1812, ii, 223.

known to cure others. And they are not allowed to pass by a sick person in silence, without inquiring into the nature of his troubles." In our modern day, it is not necessary to invoke the aid of the law to accomplish the same result.

Israel

The Hebrews did a number of important things for the hygienic well-being of civilized man. The following passage from Deuteronomy (xxiii, 9-14) on the policing of a military camp is interesting:

"9. When the host goeth forth against thine enemies, then keep thee from every wicked thing.

"10. If there be among you any man that is not clean by reason of uncleanness that chanceth him by night, then shall he go abroad out of the camp, he shall not come within the camp.

"11. But it shall be, when evening cometh on, he shall wash himself with water; and when the sun is down, he shall come into the camp again.

"12. Thou shalt have a place without the camp, whither thou shalt go forth abroad.

"13. And thou shalt have a paddle upon thy weapon; and it shall be when thou wilt ease thyself abroad, thou shalt dig therewith, and shalt turn back and cover that which cometh from thee;

"14. For the Lord thy God walketh in the midst of the camp, to deliver thee and to give up thine enemies before thee; therefore shall thy camp be holy; that He see no unclean thing in thee, and turn away from thee."

India

In ancient India medicine was a matter of incantations against disease and injury, with a certain amount of herbal therapy. In the medical treatise of Susruta (4th century, B. C.) there is a chapter on "the mode of preserving the life of a king whose soldiers are on the march," from which the following may be quoted:

"A common practice of the enemy under such circumstances is to poison the wells on the roadside, the articles of food, the shades of trees (shadowy places), and the fuel and forage for

cattle; hence it is incumbent on a physician marching with the troops, to inspect, examine and purify these before using any of them, in case they be poisoned.

“A physician, fully equipped with a supply of medicine, should live in a camp not remote from the royal pavilion, and there the persons wounded by shafts of arrows or any other war projectiles, or suffering from the effects of any imbibed poison, should resort to him (the physician), conspicuous like a triumphant ensign for his fame and professional success.

“The (proper) medicine is that which consists of drugs grown in countries most congenial to their growth, collected under the auspices of proper lunar phases and asterisms, and compounded in proper measures and proportions, and which is pleasing (exhilarating to the mind) and has the property of subduing the deranged bodily humours without creating any discomfort to the patient, and which is harmless even in an overdose, and is judiciously administered at the opportune moment.

“That person alone is fit to nurse or to attend the bedside of a patient, who is cool-headed and pleasant in his demeanor, does not speak ill of anybody, is strong and attentive to the requirements of the sick, and strictly and indefatigably follows the instructions of the physician.”³

The Indian *materia medica*, dietetics, surgery, with the rules for the hygiene and nutrition of infancy, were the best in this period of antiquity. The Indian mode of splinting fractures with bamboo withes was adopted in the British Army. The soporific effects of opium, hyoseyamus, and cannabis indica, were known. Hypnotism was also employed in surgical operations. Surgery was taught by having the students practice swiftness and surety of incision upon gourds, melons, lily stalks, etc.; bandaging was practiced upon flexible models, and venesection was learned by puncturing the veins of large green leaves. The Hindus were aware that mosquitoes were somewhat associated with the transmission of fevers. Susruta, in the 4th century B. C., made the interesting observation that, when rats fall from the rafters, jump about and die, bubonic plague is at hand. It took the

³ Susruta Samhita, English translation by K. L. Bhisnagrata, Calcutta, 1907, i, 303-307.

world some two thousand years to realize finally the full significance of that observation.

Greece

The battle formation described in the Iliad (iv, 297) was of the phalanx order, with infantry in the rear, horsemen and charioteers in the front line, and "cowards in the middle." Battles began with individual skirmishing and trial combats, the horse and chariots going to the rear before an infantry assault, but taking the front line in a general advance. A wounded hero was dragged or borne out of danger by his comrades, sometimes placed under a tree to die, but was usually taken to a chariot which bore him to near-by huts. Here he was given a stimulating draught of wine, the "wound-drink" of the Middle Ages, his clothing was loosened in the region of the wound, which was then washed with warm water and, if necessary, further examined. An imbedded spear or arrow point was either withdrawn or cut out by widening the wound. The wound was then treated with various herbs relieving pain or with the juice of some bitter root and finally bound up with a woolen bandage.

War was the only school for surgery at this time. Hippocrates says in "The Physician": "Fights between citizens and their enemies are rare, but frequent and almost daily between mercenary soldiers; he who would become a surgeon therefore should join an army and follow it." With the Spartans, continuous military duty was obligatory between the ages of twenty and sixty, while in the other Greek states young men were trained for two or three years and released from duty until the hour of need. The Spartans had a regular medical service as suggested by the law of Lycurgus that the army surgeons retire to the rear of the right wing during an engagement.

Herodotus and Xenophon have given us considerable information about the medical arrangements of the Persian Army. This great army, strong in cavalry, originally made up of Persians alone, was, at the time of the expedition against Greece, augmented by a huge levy of all nationalities. The physicians of the Persian Army and fleet were mercenaries, usually Egyptians or Greeks. One of the latter, Democedes of Croton (520 B. C.), a high-salaried health officer, being retained at the court of Darius

as a captive, led an advance guard of Persian spies into Greece in order to get back to his home town (Herodotus, iii, 131-137). Herodotus has little to say of organization but has many interesting anecdotes, *e.g.*, of the mortality of the Persian Army from gluttony and change of water supply, of their sufferings from epidemic diseases, of a traumatic hemoptysis following a fall from a horse, of various wounds, of the treatment of wounds with dressings of myrrh and flaxen bandages, and of the deaths of Cambyses and Miltiades from traumatic septicemia or gangrene.

Xenophon (444-357 B. C.) was one of the generals commissioned by the younger Cyrus to raise an army of 10,000 Greek mercenaries for his expedition against Artaxerxes. After the defeat and death of Cyrus at Cunaxa (401 B. C.), Xenophon conducted the retreat from Babylonia back to their own country. In the narrative of this retreat contained in the *Anabasis*, there is only one mention of medical service (iii, 4):

“Marching thus for the rest of the day, some on the road over the hills, others advancing abreast of them over along the mountains, they came to the villages, and eight surgeons were commandeered, for there were many wounded. Here they remained three days, both on account of the wounded and because they had found, at the same time, abundant supplies, *viz.*, wheat-flour, wine and barley, which had been stored up for horses. These supplies had been collected for the then satrap of the country. But on the fourth day, they went down unto the plain. When, however, Tissaphernes overtook them with his command, necessity taught them to encamp at the nearest village and not to fight while marching; for there were many unfit for action, *viz.*, the wounded, those carrying the wounded and those who bore the arms of such carriers.”

It will thus be seen that they went to a great deal of trouble to give the best possible care and attention to those who had become casualties.

To lighten the march, the arms were sometimes carried in the wagons, the wounded usually on the backs of comrades, and one bearer was publicly scourged, by order of Xenophon, for trying to bury a wounded man to get rid of his burden. The troops suffered much from cold and frostbite in Armenia, many freezing to death, others laboring under snow-blindness. Arrow wounds

are mentioned, experiences with poisonous honey, and headache from date-wine, and it is of record that potable water was boiled by the Persians for Cyrus in silver kettles.

In the *Cyropaedia* (iii, ii, 12) we are told how Cyrus detailed physicians to treat wounded prisoners:

“At this juncture they brought to Cyrus the prisoners in chains and also some that had been wounded. And when he saw them, he at once ordered that the fetters be taken off, and he sent for surgeons and bade them attend to the wounded men. And then he told the Chaldeans that he had come with no wish to destroy them and with no desire to make war, but because he wished to make peace between the Armenians and the Chaldeans.”

Rome

As early as 502 B. C., it was customary for the Roman armies to take their wounded with them after a battle, to stay with them until they could be moved, or to leave them in a safe place.

The bad effect of epidemic disease upon morale is indicated in the account by Livy of the siege of Syracuse, 212 B. C.:

“They were visited too by a plague; a calamity extending to both sides, and one which might well divert their attention from schemes of war . . . afterwards, the disease was spread by merely attending upon and coming in contact with those affected; so that those who were seized with it either perished, neglected and deserted, or else drew with them those who sat by them and nursed them, by infecting them with the same violence of disease. . . . At last, their feelings had become so brutalized by being habituated to these miseries, that they not only did not follow their dead with tears and decent lamentations but they did not even carry them out and bury them; so that the bodies of the dead lay strewn about, exposed to the view of those who were awaiting similar fate; and thus the dead were the means of destroying the sick, and the sick those who were in health, both by fear and by the filthy state and the noisome stench of their bodies. Some, preferring to die by the sword, even rushed alone upon the outposts of the enemy” (XXV, 26).

The above is especially interesting in showing that Livy (59 B. C.–17 A. D.) had some notion of contagion. It is also interesting as a contrast to our modern knowledge and control of the infectious diseases.

Livy also noted that more died from battle wounds than were killed on the field (310 B. C.): "And among the Romans, so numerous were the wounds that more wounded men died after the battle than had fallen on the field" (IX, 32).

Cicero, in his second Tusculan Disputation (*circa* 70 B. C.), says: "If we notice how the wounded, borne in from the line of battle, behave themselves, it will not escape our observation that raw recruits make shameful outcries over slight wounds, while the experienced, seasoned soldier is pluckier and merely looks around for a surgeon to apply the dressing."

Caesar distributed his wounded in places occupied by Romans,⁴ and his subaltern field-commander, Labienus, had advanced far enough in methods of evacuation to send his wounded to Adrumetum in wagons for treatment (46 B. C.).

It is quite evident that the Romans had a well-organized medico-military personnel. Each of the 25–30 legions, of ten cohorts each (6,500–7,000 men in all), appear to have had a legionary physician; each of the nine Pretorian cohorts, the four urban cohorts, and the seven cohorts of *vigiles* (who acted as police and firemen in the city), had four cohort surgeons. Every body of auxiliary troops and every ship of the Pretorian fleet also had physicians. They were ranked among the non-commissioned officers. Their social status was on a par with accountants, notaries, registrars, secretaries, and civilian functionaries of all kinds.

Their uniform consisted of a double woolen undershirt, a short scalloped doublet, leather breeches reaching to the calves, and to which the boots were attached, a round metal helmet, not covering the neck, and the traditional short sword, attached to a belt. The surgical kit consisted of metal knives, scalpels, hooks, sounds, forceps, etc., carried in a long slender bronze case.

The excavations of three Roman hospitals, military, near Vienna, Bonn, and the Swiss Baden during 1887–1904 have given us some idea of the status of hospital construction and administration in antiquity. The excavations near Bonn, by Koenen,⁵ unearthed the remains of a stone hospital 90 by 50 meters in di-

⁴ Caesar: *De bello civili*, III, 75, 78, 2.

⁵ C. Koenen: *Beschreibung von Novaesium*. Bonn, Jahrb., 111–112, pp. 180–182.

mensions, built on the corridor plan, with wards opening into closed corridors, the dining-room facing the main entrance and situated between the two main quadrangles. The 38 sick wards were probably intended for 5-6 patients each. Many surgical instruments and ointment boxes were found in the ruins as well as evidence of a diet kitchen. The other hospitals excavated were of a similar character.

The Romans were a clean people and were careful to enforce certain sanitary requirements in the selection of their camp sites and for the policing of the camp. It is interesting to note that they had a suspicion that marshes engender certain substances inimical to health. Vitruvius (1st century A. D.) says: "The vicinity of a marsh is to be avoided, because, when the morning airs reach the house at sunrise, the mists of these places arrive with them, and the wind, mixed with these vapors, spreads the poisonous exhalations of the creatures inhabiting the marsh, and so makes the place pestilential" (I., 4). Columella says: "Nor should buildings be erected near a marsh nor a military road adjoin it, because through heat it gives forth noxious poisons and engenders animals around with dangerous stings, which fly at us in dense swarms" (I., 5). As in the case of plague, it took the world centuries to arrive at the real solution of the reason for the dangerous character of swamps and the relation of the insects bred therein to certain diseases.

After the second Punic War the wounded were carried by the *velites* to the rear, thence to tents or huts, where their wounds were bound, or else they were billeted in the houses of the wealthy, or sent to a safeguarded place, sometimes by wagon transportation. As long as the fighting was within the Italian peninsula and near Rome this was possible, but when warfare was carried into distant lands, new arrangements had to be made. For this, provision appears to have been made to establish hospitals in connection with their camps both for sick and wounded soldiers and for animals. The hospital personnel consisted of hospital superintendents, the physicians, the sanitary personnel, who carried bandaging material in a pouch and were attended by pupils, the paper work personnel, and those who waited on the sick. It sounds very much like the personnel for a modern camp hospital.

Military medicine, which had reached a comparatively high standard during the height of the Roman power, suffered considerable retrogression during the succeeding period.

The Middle Ages

During this period of approximately a thousand years, medicine, along with science in general, made little advance.

In the Western Roman Empire the deterioration was especially noticeable, though the Eastern Empire continued to maintain an efficient army with an adequate medical personnel.

The *Tactics* of Emperor Leo contains the following passage on the necessity of medical personnel which shows an appreciation of the effect upon morale of proper care of the wounded:

“Give all the care you possibly can to your wounded for, if you neglect them, you will make your soldiers timorous and cowardly before a battle and, not only that, but your personnel, whom you might preserve and retain by proper consideration for their health and welfare, will be otherwise lost to you through your own negligence.”⁶

Vegetius⁷ (375–392 A.D.) lays down certain rules concerning camp sanitation which are for the most part applicable to-day:

“Vegetius maintains that large bodies of troops should not camp too long in any one place, since epidemic diseases arise from corruption of the air and water and can only be prevented by frequent change of camp. Troops should not camp upon dry hillsides, devoid of shade, and, in summer, should always be provided with tents. One drink of polluted water may be ‘as potent as poison’ in starting an epidemic. Daily exercises, in the opinion of experienced commanders, are better for the health of soldiery than physicians. In periods of great heat all marching should be done before sunrise. In winter little can be expected of the soldier if he is allowed to freeze. There should be no lack of fuel and clothing. Hunger is more cruel than the sword. Recruits from cold climates are hardier and more resistant to disease than those from warmer climates; and the army must be

⁶ Leo: *Tactica*. Epilogue (Leyden, 1612, p. 381). Cited by Habering, p. 70.

⁷ Vegetius: *De re militari*, iii, 2. Cited and translated by Frölich, *op. cit.*, 311–312.

continually strengthened by recruits from the farmlands, who are stronger than the city-bred. The recruit should be young, but strength is more essential than size; he should be keen-eyed, with head erect, broad chest, long muscular arms, capable hands, slender flanks, with thighs, calves, and feet not distended by superfluous flesh but hard with accumulated muscle. It is best to discharge the unfit at once. It is the duty of commanding officers to provide good water, proper food and medical attention for the sick. The camp commander should look after the patients in their tents, the physicians who attend them and the expenses incident thereto."

The feudal system exercised a most deleterious effect upon military medicine. The high officials were attended by the few capable physicians and surgeons but the individual soldier was sadly neglected. There was no organization for the care of wounded, and a soldier who suffered a severe wound was in a distressing plight—in reality, he was better off if the wound proved immediately fatal.

The great Mongol raids of the Middle Ages were characterized by brutal massacres of the enemy's wounded and fatalistic Oriental indifference to their own.

In France, England and Germany, the general practice of surgery was in the hands of barbers and bath-keepers. These individuals extracted teeth, gave enemata, and performed such minor operations as venesection, cupping and leeching.

A real advance is seen in the accounts of camp hospitals and ambulance service as noted in the chronicles of the conquest of Granada and the expulsion of the Moors by the armies of Ferdinand and Isabella. The following extract from the account of the siege of Alora (1484), by Hernando del Pulgar,⁸ is of interest in this connection:

"For the care of the sick and wounded, the queen sent always to the camp six large tents and their furniture, together with physicians, surgeons, medicines and attendants; and commanded that they should charge nothing, for she would pay for all. In the camps, these tents with their appointments were called the Queen's Hospital."

⁸ Hernando del Pulgar: *Cronica de los Reyes Catolicos* (iii, 33). Valencia, 1770, 230.

The long period of stagnation of the Middle Ages finally came to an end and there appeared an increasing development of the arts and sciences in general, marked in the succeeding stage of the world's progress by such great figures as Leonardo da Vinci, Michael Angelo, Shakespeare, Copernicus, Paracelsus, Vesalius and Paré.

The Renaissance

Comment on this period will be limited to a short reference to three of the outstanding figures just mentioned.

Paracelsus (1491–1541) in his "Larger Wound-Surgery" (1536) makes an illuminating observation concerning the treatment of wounds:

"Warily must the surgeon take heed not to remove or interfere with Nature's balsam but protect and defend it in its working and virtue. It is in the nature of flesh to possess, in itself, an innate balsam which healeth wounds. Every limb has its own healing in itself; Nature has her own doctors in every limb; wherefore every surgeon should know that it is not he, but Nature, that heals. What do wounds need? Nothing. Inasmuch as the flesh grows from within outwards, and not from without inwards, so the surgery of a wound is a mere defensive, to prevent Nature from suffering any accident from without, so that she may proceed unchecked in her operations."

This shows a keen understanding of the processes of wound repair and of the danger of infection from outside sources.

"Paracelsus was the founder of chemotherapy, taught that medicine and surgery are one (*einerlei*), stood for rational wound-treatment, opposed witchcraft, starcraft and uromancy, was the first to analyze mineral waters and made real additions to the pharmacopoeia. He was the first to write on miners' diseases, described miners' phthisis and the effects of choke damp, saw gout and stone as diathetic diseases, and noted the correlation between goitre and myxoedema. His motto was: Experimentation controlled by the authoritative literature."

Vesalius (1514–64) was the founder of modern anatomy, which he taught first by public dissection. He published "Fabrica" in 1543. In the copy of this treatise in The New York Academy of Medicine, Dr. William Osler has written: "The greatest book ever printed, from which modern medicine dates."

Vesalius was the first to describe aneurism of the thoracic and abdominal aorta.

Ambroise Paré (1510–90) was probably the greatest of military surgeons when one takes into consideration the period during which he lived and the state of the art at that time. He invented many surgical instruments, introduced artificial limbs and eyes, the truss, implantation of teeth, reintroduced massage and podalic version, described pyemia, the effect of prostatic hypertrophy and fracture of the neck of the femur, saw flies as possible carriers of wound infection and was the first to suggest the syphilitic origin of aneurism.

On the expedition of Francis I to Turin (1536–7) Paré had an instructive experience with the method of wound treatment then in vogue. He describes it thus:

“Now I was at this time a fresh-water soldier; I had not yet seen wounds made by gunshot at the first dressing. It is true I had read in John de Vigo’s first Book, ‘Of Wounds in General,’ eighth chapter, that wounds made by firearms partake of venosity by reason of the powder; and for their cure he bids you cauterise them with oil of elders scalding hot mixed with a little treacle. And to make no mistake, before I would use the said oil, knowing this was to bring great pain to the patient, I asked first before I applied it, what the other surgeons did for the first dressing; which was to put the said oil, boiling well, into the wounds, with tents and setons; wherefore I took courage to do as they did. At last my oil ran short and I was forced instead thereof to apply a digestive made of the yolks of eggs, oil of roses, and turpentine. In the night I could not sleep in quiet, fearing some default in not cauterising, that I should find the wounded to whom I had not used the said oil dead from the poison of their wounds; which made me rise very early to visit them, where beyond my expectation I found that those to whom I had applied my digestive medicament had but little pain, and their wounds without inflammation or swelling, having rested fairly well that night; the others, to whom the boiling oil was used, I found feverish, with great pain and swelling about the edges of their wounds. Then I resolved never more to burn thus cruelly poor men with gunshot wounds.

“While I was at Turin I found a surgeon famed above all others for his treatment of gunshot wounds; into whose favor I found means to insinuate myself, to have the recipe of his balm, as he called it, wherewith he dressed gunshot wounds. And he made me pay my court to him for two years, before I could possibly draw the recipe from him. In the end, thanks to my gifts and presents, he gave it to me; which was to boil in oil of lilies, young whelps just born and earth-worms prepared with Venetian turpentine. Then I was joyful and my heart made glad, that I had understood his remedy, which was like that which I had obtained by chance.

“See how I learned to treat gunshot wounds; not by books.”⁹

17th Century

The 17th century was marked by the demonstration of the circulation of the blood by Harvey in 1616 and his publication of this important contribution in 1628.

Military medicine showed no great advance during this period. The pharmacopaeias of the time were remarkable for the nauseating and loathsome ingredients they contained, such as oils of vipers and angleworms, beetles, ear-wigs, powdered mummy, etc.

A field-chest devised by Muralt for the Bavarian artillery in the Turkish campaign of 1688 is described by J. Schuster (*Deutsche mil.-arztl. Ztsch.*, Berl., 1916, XLV, 123-131). It weighed 320 pounds and contained 30 surgical instruments and matériel, with 197 remedies, including 3 pounds of theriac (an opiate antidote of 64 ingredients), mithridate (49 ingredients), tincture of benzoar, Pannonian powder (mostly red sandal-wood), pulvis ad casum (*i.e.*, for any emergency, containing rhubarb, terra sigillata, palm-juice, spermaceti and mummy dust), scorpion oil, rainworm oil, zinc oxide, Vigo's plaster of frog-spawn and mercury, human fat, dog's fat, rhubarb, jalap, aloes, senna, tartar emetic, Peruvian bark, mercurials, sugar of lead, alum, guaiac, saffras, squills, cantharides, hartshorn, sal ammoniac, camphor, opium, etc.

⁹ From “The Journey to Turin in 1536” in Paré's *Apologia et Voyages*; translated by Stephen Paget in his *Ambroise Paré*, New York, 1897, 33-35.

Sir Kenelm Digby's "sympathetic powder" for healing wounds at a distance and the "weapon salve," which was applied to the weapon instead of the wound, were universally employed.

As in the time of Hippocrates, war was the only field in which surgery could be learned. The capable surgeons numbered not more than a half-dozen for the entire century, and the surgery of the soldier remained largely in the hands of the barber and the bath-keeper as in the Middle Ages. The executioner, by the skill acquired in breaking bones on wheels and other forms of torture, was supposed to be an expert in bone-setting.

In January, 1629, an ordinance of Richelieu established the first stationary hospitals in the rear of armies in the field, and a state document of 1630 demonstrates the existence of one of these base hospitals at Pigneval with adequate medical and surgical personnel.

However, the poor construction and administration of the military and naval hospitals, which consisted of little else than spacious halls in which the squalid patients were crowded three in a bed, made them nests of infection and engendered the horror of hospitals which persisted until recent times. The streets of Paris and the other large towns swarmed with lame and mutilated soldiers whose status as depicted in the etchings of Callot, was that of squalid beggary.

This makes an interesting comparison with the care given to wounded soldiers at the present time, when enormous sums are expended to restore them to health or to care for those who are permanently incapacitated.

Lack of knowledge concerning the cause of the various infectious diseases and the methods to attack them successfully resulted in tremendous epidemics of such diseases as typhus, dysentery, typhoid fever and plague whereby armies were frightfully scourged. The infection was conveyed also to the civil communities and widespread outbreaks resulted with tremendous mortality. An outstanding instance is recorded in the devastating epidemics occurring during the Thirty Years' War. By the end of the war, Germany was a ruined country, its population reduced from 16-17,000,000 to 4,000,000 (Lammert).

In 1606, Tobias Cober, a physician of Görlitz (Bohemia), described the discomfort and disability associated with pediculosis.

“With these foregather the most terrible pediculi, hardly to be thought of without a sense of discomfort, which in themselves, through their constant promenading and sucking of the body, are enough to stir up one’s bile. For it is impossible to avoid the bites of these miserable creatures, especially in the first years in the field, as they enjoy a sort of right of citizenship in all camps. The atmosphere is so lukewarm, mild and stuffy that when clothes which have been washed in swamp water are exposed to the sunlight, they are seen to swarm with these ‘vermibus Syllanis.’ One cannot hope therefore to get away from these constant attendants and companions, as they seem to arise from the very moisture of the body itself. At first I thought to rid myself of the pest by constant change of newly washed clothing, but even this seemed to bring them more and more into play, instead of destroying them. And this phthiriasis, which even the Egyptian magi of old could not produce, but which in these localities every one can create in his own person, can, as I bear witness, drive a man into fury. For as often as I was bitten by these miserable, abject animalcules, I gave full rein to my anger, fairly gnashing my teeth with rage, and cannot even now think of them without vexation. . . . One cannot ward off these armed six-footed Turks even with iron and steel. . . . And among many soldiers I have noted the frightful spectacle that this fearful plague of lice had gone far enough to cover the whole nape with ulcers, the flesh not only excoriated to the breadth of one or two fingers, but actually excavated, the men condemned to this miserable fate dying with groans and lamentations.”

This description is particularly interesting in view of the widespread distribution of this pest in the field during the World War. At one time it was estimated by one of our Allies that 90% of the illness from which their troops suffered was due to skin diseases. The latter were largely scabies and pyodermias, the latter resulting from infected scratch wounds caused by louse infestation.

The American Revolution

The foregoing discussion, which has been necessarily of a sketchy character, brings us to the period during which the United States of America came into existence as a nation.

Though it would be interesting to follow the progress of military medicine in the other nations during the 18th century and prior to the American Revolution, time will not be taken for this purpose and we will confine ourselves to a discussion of the development of our Army Medical Department.

Prior to May 8, 1775, no organization existed for the care and treatment of the wounded in the American forces. In such engagements as the Concord or Lexington fights, the wounded were attended by private physicians who later presented bills for their services. These physicians had no military status or authority.

On May 8, 1775, The Provincial Congress, in the Colony of Massachusetts Bay, ordered that a committee of physicians, appointed by the Congress, examine as to professional qualifications all persons recommended for appointment as surgeons to the several regiments by their commanding officers. As described by Thacher in his *Military Journal* of 1775, the examinations in anatomy, physiology, surgery, and medicine, were so rigorous that a perspiring candidate, when asked how he would promote sweating in a rheumatic patient, replied: "I would have him examined by a medical committee." This was an auspicious start and indicates that the candidates were looked over very thoroughly before they were accepted for service.

After the battle of Breed's Hill, June 16, 1775, hospitals were established at Cambridge, Watertown, Roxbury and elsewhere, with regulations drafted by the Congress, and appropriate warrants were issued to the hospital surgeons and mates. At this time, the medical establishment of the Army was known as "The Hospital."

July 19, 1775, The Colonial Congress in Philadelphia appointed a committee to consider ways and means of establishing the Hospital. This was strongly recommended by General Washington on July 21.

July 27, 1775, Congress reported a bill for its organization, which was adopted. Dr. Benjamin Church became Director-General and Chief Physician at a salary of four dollars per diem. With this appointment there began a series of unfortunate experiences connected with the head of the medical establishment.

October 3, 1775, Director-General Church was tried by a council of war for treasonable correspondence with the enemy and was imprisoned.

October 17, 1775, Dr. John Morgan was appointed to succeed Church. Morgan had been instrumental in organizing the medical department of the University of Pennsylvania. He rendered most valuable services but was unjustly dismissed from the Army on January 9, 1777. Following this action, Morgan prepared and published his "Vindication" (1777), and received a tardy but handsome exoneration from Congress on June 12, 1779. His dismissal was due in part to the increasing sickness among the troops, the difficulty in supplying them with medical supplies, but principally to a system of divided authority which was in existence at that time.

April 11, 1777, Dr. William Shippen was appointed to succeed Morgan. Shippen was tried by court-martial in 1780, but was acquitted and was reappointed Director-General on September 30th of the same year. John Cochran was appointed "Chief Physician and Surgeon" at the same time.

During the war, Washington manifested the keenest interest in the welfare of the medical establishment, particularly in his instructions to Morgan for the removal of the Hospital to New York (April 3, 1776), his letters to John Hancock on the dubious and jealous character of the regimental surgeons and their intrigues against the Hospital (1776-1777), and his letter of approval of Shippen's and Cochran's plan for reorganization (February 14, 1777).

The first hospital regulations were drafted by Morgan after conference with Washington and the regimental surgeons and were published in July, 1776.

Baron von Steuben was appointed Inspector-General of the Army in May, 1778, at the instance of Washington. In 1780 he prepared and published our first Army Regulations, of which a portion was devoted to the medical establishment. The latter stressed the value to morale of the officers' attention to the health of their troops, provided for the setting aside of two or three tents for a regimental hospital, bed sacks for the sick, two to each company, morning sick call, weekly report of sick to the regimental commander (oftener when necessary), care of the arms and accoutrements of a sick soldier, that the surgeon should be the sole judge as to when a sick soldier was strong enough to return to duty, and that the surgeon should accompany the troops on the

march as well as in camp. Many of these regulations are still in force in the Army and show therefore how sound they were.

In 1776, Dr. John Jones published a treatise on wounds and fractures, which was the first American book on surgery, and, through the appendix on camp and military hospitals, our first book on military medicine.

In 1777, Benjamin Rush published his pamphlet on the hygiene of troops, and Shippen drafted a plan for flying ambulances, while in 1780 James Tilton introduced log-hut hospitals.

Naturally, with the lack of any organization when the war broke out, there was much suffering among the sick and wounded. Two types of hospitals were in use—small regimental hospitals and the larger general hospitals. The former were with the troops and were of several types. Some were in tents while others were in huts. The huts were called at times “The Flying Hospital.” They have been described as follows: “The Flying Hospital huts are to be 15 feet wide, and 25 feet long in the clear and the story at least 9 feet high—to be covered with boards or shingles only without any dirt—a window made at each side and a chimney at one end. Two such hospitals are to be made for each brigade in their rear as near the center as may be; and, if the ground permits of it, not more than three nor less than one hundred yards from it.”¹⁰

The following extracts from letters from prominent officers indicate clearly the lack of supplies and equipment for care of the sick and wounded:

“We shall be hard set to get the sick away; our hospital, or rather house of carnage, beggars all description and shocks humanity to visit. The cause is obvious; no medicine or regimen on the ground suitable for the sick; no beds or straw to lie on; no covering to keep them warm other than their own thin and wretched clothing. We cannot send them to Fort George as usual, the hospital being removed from this place to Albany, and the weather is so intensely cold that before they would reach there, they would perish.”¹¹

¹⁰ Valley Forge, January 13, 1778. War of the Revolution Orderly Book, July 7, 1777, to April 25, 1778, Volume 20, A.G.O. Old Records, p. 28.

¹¹ Letter from General Gates to General Schuyler, Ticonderoga, 1 December, 1776. *American Archives*, Fifth Series, Volume III, 1776, p. 1031.

“ . . . I feel a degree of happiness that the Congress are going to put the hospital department upon a better establishment, for the sick this campaign have suffered beyond description and shocking to humanity. . . . ”¹²

“ . . . The wretched condition they are now in for want of almost every necessary of the conveniences of life, except flour and bad beef, is shocking to humanity and beggars all description. We have neither beds or bedding for our sick to lay on or under, other than their own clothing; no medicine or regimen suitable for them; the dead and dying laying mingled together in our hospital, or rather house of carnage, is no uncommon sight. . . . ”¹³

It is a remarkable tribute to the courage and tenacity of purpose of our forefathers that they were able, under such distressing circumstances, to bring the war to a successful conclusion.

An interesting light is thrown on methods of evacuation by the following extract from *American Archives*, Volume V, 4th Series, page 113:

“Headquarters, Cambridge, March 4, 1776.

“ . . . The Colledge to be appropriated for the regimental sick and such as may be wounded. Suitable barracks at Prospect Hill be placed in immediate readiness to receive at least 100 wounded. Necessary men to be detailed to assist in carrying wounded to the hospital. Hand barrows and other proper means to be provided for their removal.”

The use of hand barrows for the removal of wounded could hardly have been either an expeditious or a comfortable method of evacuation.

The British troops suffered much also from illness and lack of supplies. Their regimental hospitals are described by Gore as “simple collections of sick men huddled together” without organization, regulations, clothing, or rudimentary comforts.

After Yorktown, October 19, 1781, Congress rapidly demobilized the Army and the Hospital Department was practically disbanded.

¹² General Greene to the President of Congress, Corryell’s Ferry, Delaware, December 16, 1776. Page 1246, same reference as above.

¹³ Anthony Wayne to the Committee of Safety for the State of Pennsylvania, Ticonderoga, December 4, 1776. Page 1359, same reference.

On June 2, 1784, Congress resolved "That the commanding officer be, and he is hereby, directed to discharge the troops now in the service of the United States, except twenty-five privates to guard the stores at Fort Pitt and fifty-five to guard the stores at West Point, and other magazines, with a proportionate number of officers; no officer to remain in service above the rank of captain, and those privates to be retained who were enlisted on the best terms: Provided: That Congress before its recess shall not take other measures respecting the disposition of those troops."

The Army therefore practically disappeared, though Congress on the next day (June 3, 1784) passed a resolution recommending that certain States furnish 700 militia to serve for twelve months. Of these, Connecticut was to furnish 165, New York 165, New Jersey 110, and Pennsylvania 260.

From this time on to the War of 1812, there was considerable fluctuation in the forces authorized as, for example, on May 3, 1798, war with France being imminent, Congress authorized an army of 10,000 men with James Craik as Physician-General (1798-1800).

In May-June, 1800, the above forces were disbanded. This action was taken when it became a certainty that there would be no war. Doctor Craik was mustered out together with all other medical officers except six surgeons and twelve surgeon's mates.

In 1812, the Army was again increased by reason of the war with Great Britain, and Doctor James Tilton, of Delaware, was appointed Physician and Surgeon-General.

War of 1812

In spite of the distressing experiences and the general inefficiency so conspicuous during the Revolutionary War, the United States entered the War of 1812 totally unprepared and proceeded to duplicate the unfortunate mismanagement of the care of the sick and wounded.

This war did not contribute anything especially new in its medical aspects. The same general methods seem to have been followed in the collection and treatment of the sick and wounded as were in use during the Revolution. The following extracts

from certain reports read very much like reports previously cited from Revolutionary records:

“After which, detachments were sent out with waggons to search the woods and collect all the wounded and dead and to bring them to the ground occupied by the troops. After this was completed, all the Indian houses were prepared, amounting to three or four, and the wounded moved into them, as it began to rain and the surgeons were industriously employed with them during the whole night. Battle began 3:30 P. M. and lasted 2½ hours. Eighteen Americans were killed and 63 wounded.”¹⁴

“ . . . The Surgeon has now in the hospital tents at camp about forty men, most of whom he is apprehensive will not survive. The balance of the sick he is obliged to permit to remain in their tents, having no room for them. Some have the measles, others a fever, which is becoming every day more alarming.

“The field officer of the day has also taken a view of the hospital tent of the 13th regiment. Five men were lying there dead. He was told they had been dead for 24 hours and were not buried for want of coffins. The sides of the tent had been forced open by the wind.”¹⁵

The medical officers in the War of 1812 appear to have worked with great energy and fidelity but were handicapped tremendously by lack of equipment and supplies. However, the lesson was not learned. The country did not take to heart the terrible sufferings of the sick and wounded, resulting largely from the policy of unpreparedness, and entered the Mexican War just as unprepared as they had entered the two previous wars, though an improvement was made in the organization of the Medical Department, brought about by the Act of Congress dated April 14, 1818, reorganizing the Army and Navy.

This act has generally been considered as the commencement of the modern history of the Medical Corps. The Surgeon-Gen-

¹⁴ Collection of the official accounts in detail of all the battles fought by sea and land between the Navy and Army of the United States and the Navy and Army of Great Britain during the years 1812, 13, 14, and 15. By H. A. Fay, late Captain in the Corps of U. S. Artillerists. New York, 1817. Printed by E. Conrad. Battle of Brownstown, August 9, 1812.

¹⁵ Letter from Captain Benjamin Forsyth to Colonel Macomb, Sackett's Harbor. Appears to have been written from Ogdensburg.

eral (Joseph Lovell) now assumed direct jurisdiction over the officers of the Corps and this constituted a great change. The organization, however, was not greatly altered otherwise from the previous organization, the only material change being the consolidation of the hospital and garrison medical officers under the denomination of Post Surgeons. It was not until the reduction of the Army in 1821 that the Corps assumed the form which it has retained without decided change up to the present time.

In the period (1833) between the War of 1812 and the Mexican War, William Beaumont (1785–1853), a surgeon in the United States Army, published his famous "Experiments and Observations." These were based on an accidental gastric fistula in a Canadian half-breed, Alexis St. Martin, and disclosed much valuable information upon the nature of the gastric juice and the process of digestion in the stomach.

This important work was carried on with true scientific zeal under most difficult conditions. It was first begun at an isolated military post in Michigan and completed by bringing St. Martin approximately 2,000 miles to Plattsburg Barracks, New York. Vaughan says: "Every physician who prescribes for digestive disorders and every patient who is benefited by such a prescription, owes gratitude to the memory 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."

Beaumont was the pioneer of experimental physiology in America and his observations form the foundation of modern dietetic tables and scales.

The Mexican War

The American Army was sadly unprepared for the Mexican War and carried it to a successful conclusion only after untold suffering from lack of clothing, supplies, rolling stock, and adequate medical administration.

At this time, the Regular Army numbered 7,500 men and the Medical Department consisted of a Surgeon-General with the rank of Colonel and 71 medical officers. This was increased by Congressional acts of 1846–47 to 115, with 135 surgeons for vol-

unteer forces (total 250). About 100,000 men were sent to Mexico during 1846-48, so that only six companies of regular troops were left in the entire United States (Duncan).

There appears to have been little forethought or realization as to the requirements of such a campaign in a foreign country and, as a consequence, the results from a medical standpoint were distressing. Ignorance of the character of water supplies brought hundreds down with diarrhœa and dysentery. Hospitals were hastily improvised in any convenient buildings and the misery of the sick was increased by the squalor of the Latin surroundings. Conditions improved after the entry into the Mexican capital when General Scott levied \$20,000 for the sick in hospital. He also levied \$100,000, which was wisely utilized for the establishment of the United States Soldiers' Home in Washington, D. C. This institution has expanded into a splendid retreat for the aged and disabled veterans of the Regular Army.

The following extracts from accounts of two officers who participated in the campaign throw considerable light on conditions existing at the time.

“. . . The ambulances, light four-horse wagons on springs, invented, as you know, by Baron Larrey . . . are already kept very busy, carrying the sick from the camp to the general hospitals in the city.” “Camp Vergara—near Vera Cruz—July, 1847.”

“The sun was very powerful and the men . . . threw away, first watch coats, then their extra garments, their knapsacks, blankets—many of them, in short, threw away everything but arms and accoutrements.”

“The sick had a trying time of it . . . they fell by dozens, or hundreds, I should say, by the roadside. We put as many of them in the ambulances as they would hold and, when possible, we would put a man on top of the stores in the overladen wagons, but they fell too fast for us and all we could do at last was to recommend them to hold on to the tails of the wagons.” “San Juan—July, 1847.”

“Dire disease still pursued us. Our ambulances, or avalanches as the men call them, were full and overfull. The wagons of the train were pressed into service in addition to their proper loads.” “Puebla de los Angeles—August, 1847.”

“In the meantime, San Augustin was becoming a grand hospital. The surgeons, following the movements of the army, did all that men could do in the field for the wounded. Night and day without shelter in sun and rain, they gave their devoted attentions. After the first temporary dressings, they sent their wounded to the various establishments converted for the time into hospitals.” “San Augustin Valley of Mexico—August, 1847.”

“I found my professional brethren getting out their instruments and dressings, arranging their tables, etc., for operations, and having done the same, I mounted to the roof to gaze at the rare spectacle before me until my services should be called into operation.” “City of Mexico—September, 1847.”

“The wounded were brought in rapidly; the ‘laborers were few’ but most diligent in their duties; yet the wounded suffered greatly for want of commonplace comforts. Such bedding as could be collected about the building was spread for them but by far the greater part of them lay on the floor or on the forms used by the scholars, for the castle was a military academy also, the West Point of Mexico.” “City of Mexico—September, 1847—Battle of Chapultepec.”¹⁶

The following notes have been abstracted from “Medical and Surgical Notes of Campaigns in the War with Mexico during the years 1845–46–47–48, by John B. Porter, Surgeon, U. S. Army.” From the *American Journal of the Medical Sciences*, January, 1852, Volume XXIII, New Series.

“Each regimental hospital had two or three large hospital tents, and when they were too much crowded or particularly long and severe cases occurred, patients were transferred to the general hospital, which was a long frame building in the village of Corpus Christi. The hospital tents were fitted up with stoves in the winter and were quite comfortable.”

“I have often regretted that etherization was so much resorted to in capital operations at Vera Cruz during a portion of 1847; nor can I avoid congratulating both the patients and myself that

¹⁶ The above extracts were taken from *El Puchero*, or a *Mixed Dish from Mexico*, embracing General Scott’s Campaign, with Sketches of Military Life in Field and Camp. By Richard McSherry, M.D., U. S. N., late Acting Surgeon, Regiment of Marines.

before the Summer had passed away, its employment was wholly abandoned. Anesthetics poison the blood and depress the nervous system and, in consequence, hemorrhage is much more apt to occur and union by adhesion is prevented." (Volume XXIV, New Series.)

" . . . To organize the hospital was no small undertaking. There was not a single hospital steward except invalid and incompetent ones; an invalid wardmaster; the employed physicians were almost universally incompetent; no well men left for cooks and nurses when the army marched into the *tierra templada*; there was not a single kitchen table, bench, bunk, privy (with scores of dysentery patients), chamber utensils; in a word, there was nothing but the miserable sick; and; under these circumstances, the machine had to be put in motion. . . . But this discouraging state of things was gradually removed." (Volume XXVI, Vera Cruz, 1847.)

An interesting light is thrown on the conditions of field service during this period by the following extracts from a letter written by Dr. N. S. Jarvis, Surgeon, U. S. Army, dated Monterey, Mexico, October, 1846. This was published in *The New York Journal of Medicine* for March, 1847.

"On the 19th of September we encamped within four miles of Monterey, in a grove of pecan trees, called 'Walnut Grove,' where we were abundantly supplied with clear and cold water, from a stream of considerable size and rapidity, formed by the junction of numerous springs, which took their rise in surrounding lime-stone rocks. The combination of wood and shade rendered this spot admirably fitted for an encampment. On the following day parties were employed in reconnoitering the enemy, and in observation of the fortified position of the town. Towards evening my regiment, 3rd Infantry, with another, was advanced a mile towards the town, to cover a party of engineers, engaged in the erection of a Mortar Battery, but returned to camp about 9:00 P. M., having been relieved by another regiment.

"On the morning of the 21st the whole division was thrown forward towards the city, with a view, as we supposed at the time, of making a diversion in favor of the 2nd Division, under General Worth, which was moving on the western side of the city by the Saltillo road. Few of us supposed, as we silently marched

along, occasionally passing through corn fields and by the side of hedges, or whatever could conceal our movements from the enemy in their batteries, that we should so shortly be engaged in a fierce and deadly strife. As soon as, or in fact before, we emerged from under cover, the batteries from either end of the city opened their fire upon us, completely sweeping the plain in every direction, and enfilading the advancing columns of our troops, now rapidly marching towards the suburbs. The engineer officer having reported the practicability of attacking with success the rear of some of their forts, the 1st, 3rd, and 4th Infantry were ordered to advance rapidly by separate roads, and now it was my professional labors commenced; the nearest and only shelter that presented itself to me for the wounded, falling every moment under a most destructive fire, was a quarry pit. four or five feet in depth, and the same in breadth. Several of these were contiguous, and to them I directed the wounded to be carried. By stooping we were protected from the shots, which, however, became every moment thicker, owing to the fact that our troops had by this time advanced within range of the enemy's fire, and the moment they perceived a party of men bringing the wounded to us, they directed all their guns upon it. I had already performed one amputation, and was preparing for a second, when two or three fugitives rushed into the pit, falling over the wounded that lay there crowded together, saying that a large body of lancers were approaching. So little credit did I attach to their report, which I ascribed rather to their fears than the actual presence of this dreaded description of troops, that I never raised my eyes to observe them; which circumstance doubtless saved us all. Had I been discovered, all would have been massacred, as in their headlong fury they would neither have delayed to ascertain our character or profession, nor have paid much respect to our patients. Several soldiers who had sought an adjoining pit with an officer were slain. They were soon after repulsed by a regiment of Ohio and Mississippi Volunteers, marching to reinforce those already in the town, and their retreat was farther quickened by a shower of grape opened upon them by our artillery.

“I commenced with a determination of giving you a surgical history of the actions of the 21st, 22d and 23d September, but

have unintentionally thus far given a military narrative. This, however, will show, in the incidents above narrated, that the military surgeon is at times somewhat unpleasantly situated, when in the discharge of his professional duties, deprived as he is of the security, and many of the appliances enjoyed by his fellow practitioner in civil life.

“The first wounds were received in crossing the plain, and were inflicted by grape and cannon-shot. This was of course before we had approached within reach of their musketry. These wounds were all low: generally at, or just above the ankle, according to distance and direction. Of the first three men brought to me, two had received wounds from twelve-pound shots just above the ankle, which had nearly severed the limbs, which were hanging only by a portion of integuments. The other had his heel torn off by a six-pound shot. Shortly after, our troops having advanced within reach, and under the fire of the Mexican Infantry, numerous cases of wounds by musket and escopette¹⁷ balls were brought to me; these latter are one-third larger than our musket-balls, and consequently inflict a more severe and formidable wound. So numerous at this time became the wounded in our pit, and so constant and heavy the fire, directed towards the parties approaching with the wounded, as to compel us to remove our hospital several hundred yards farther in the rear. We had not long been in our new position, when some covered wagons bringing the wounded attracted the attention of the enemy, who immediately reopened their fire, compelling us a second time to remove beyond the range of their shot.

“Among the numerous projectiles, occasioning severe and fatal wounds, were grape, canister, fragments of iron and copper shells, and stones knocked by the balls from the buildings and walls. Their shells were thrown with great accuracy, frequently in the midst of a body of troops, but fortunately killing and wounding but few.

“Before speaking of any particular wounds, I will here take occasion to make some remarks respecting the character they assumed, and the peculiar causes acting to prevent a favorable result, so far as regarded the healing of all, even the most slight.

¹⁷ An escopette is a short carbine, similar to a blunderbuss, and carries a ball one-third larger than our musket. M.

The first annoyance we experienced, and which no doubt exerted an injurious effect, was one little anticipated at the time. The moment a limb was amputated numerous flies would alight on the stump, and must have deposited their eggs, for when it became necessary to dress the stump, myriads of maggots were found buried in it which could be expelled with great difficulty; rendering it necessary in some instances to reopen the flap, for their complete extermination. A much more formidable enemy made its appearance in an erysipelatous inflammation of the integuments, covering the stump, which generally set in two or three days after the operation; and notwithstanding all the means made use of to arrest it, most commonly ended in sloughing, and either proved fatal or rendered a second amputation necessary. That some influence existed previously, either external or internal, from causes connected with the state of the atmosphere, or habits of the men, arising from diet or water, was manifest. The slightest wound or scratch became in every case a tedious ulcer, in some instances proving a cause for serious alarm. Apparently the most trifling wounds required an unusual time for healing, and even those that had previously healed would break out again, and present greater difficulty in their cure than in the first instance.

“At this period no atmospheric causes apparently existed to produce this unfavorable aspect of things. Nothing could exceed the loveliness of the weather, if I may so express myself, and if the middle of the day were warm, the morning and evening refreshed us by a most delightful temperature and cloudless sky. No rain had fallen, with the exception of one or two showers, for nearly a month, and consequently little moisture existed to produce its well-known morbid influence. Immediately after the capitulation of the city, on the 25th of September, all the wounded of the different divisions entered the town, and suitable buildings were provided for their accommodation. Upwards of two hundred officers and men from the 1st and 3d Divisions, who had been most severely wounded, were conveyed thither on the same day in litters and wagons. The wounded of the Second Division already occupied the city.

“Our camp afforded no comfort nor shelter for them beyond a few small tents and a solitary blanket laid on the ground; and

many were destitute of even this apology for a bed, having lost them on our march. Many had no other clothing than that in wear, which was not only torn and soiled in climbing over the hedges, walls, etc., during the battle, but was stiff and saturated with blood from their wounds. A few days after their reception into the hospitals, tertian intermittent fever made its appearance, attacking many of the wounded, and in the majority, retarding or completely arresting convalescence. On many of those severely wounded it exerted a decidedly pernicious influence, and no doubt contributed, in some cases, to a fatal termination. It not only attacked the wounded in the hospitals, but prevailed extensively in camp and among the population of the town and neighboring country. I cannot say to what extent this may be attributed to the putrid exhalations arising from the numerous bodies of men and horses slain in the different combats, and which had been slightly covered with earth, and emitted a most sickening and offensive effluvia. This, doubtless, contributed largely towards infecting or destroying the purity of the air, and establishing a poisonous miasm.

* * * * *

“I will conclude my communication, with a statement of the number and results of the larger amputations, performed on those occasions. The total number in the three divisions of the Army was twenty-eight, *viz.*: ten in the first division, four in the second, and fourteen in the third or volunteer division. Twenty were performed on the field, or on the following morning, in the camp; the remaining eight, at subsequent periods, varying from five to twenty days. Twelve of the number, including two in those taken prisoner and operated upon by the Mexican surgeons, proved fatal, and the remaining sixteen have nearly or quite recovered. This average of mortality was not confined to our wounded. I was told by Dr. Hidalgo, surgeon in charge of the Mexican military hospital, that of thirteen amputations performed there, five had proved unsuccessful, and one case, that had recently been operated upon, appeared to me to be in a critical condition, but whether the patient died or recovered I have not learned.¹⁸ In addition to unfavorable causes, not enumerated among those I have heretofore noticed, and from which the Mexi-

¹⁸ This case subsequently proved fatal.

cans were happily exempt, was the repeated removals to which our wounded were subjected. In carrying them from the field to the camp, a distance of three or four miles, they suffered greatly; and the subsequent removal to town still farther increased the pain and danger, and in one or two cases, evidently, was productive of a fatal termination.

“With a few remarks on the appearance and condition presented by the two cases of amputations of the thigh, performed by the Mexican surgeons, in their hospital alluded to above, I will close. One of these had been operated upon on the same day with the injury, and the other some four or five days after. Neither stump on examination, after the removal of the dressings, presented any unusual appearance; on the contrary, the flaps had been neatly adjusted and brought together, and kept so by a number of interrupted sutures and adhesive straps, encircling it in every direction, and adhesion had apparently taken place, in one case along the line of divided integuments. No one judging by the external appearance of the wound, if we except a degree of paleness of the integuments of the flap and some foetor, would have suspected the condition and extent of disease within. On dressing the first case and removing the lint and adhesive straps which had become somewhat offensive, the edges of the flap receded or partially separated, so as to reveal a large cavity or excavation, the whole surface of which was dark and ill-conditioned, and from the center projected the end of the bone. There were no signs or appearance of suppuration or granulation having ever taken place in the divided muscles; on the contrary, they appeared absorbed or attenuated by previous discharge, of which none existed at this time. The patient rapidly sank, and died on the fourth day after his admission into the Division hospital.

“Private Alexander, of the Baltimore Battalion, the other case, was brought to our hospital some two days after the one above. His stump presented nearly the same appearance as the first, with no indications whatever of the diseased condition within. Eleven days after his admission the flap gave way, disclosing the same appearance as in the former case, with most intolerable foetor. Gangrene rapidly extended, and he died on the twelfth day after his admission, and the thirteenth from the time of the operation.

“Among other consequences arising from gun-shot wounds, in my hospital, were two cases of traumatic tetanus, both of which

proved fatal. The first case manifested itself seven days after the injury, which was a wound of the knee-joint, with a fracture of the patella by a grape-shot. The man was brought from the camp of the 4th Infantry to the Division hospital, and was attacked a few hours afterwards by opisthotonos, followed by trismus and severe spasmodic action of all the muscles of the body. He died the same night. The other case originated from a gunshot wound of the left thigh, in which the ball passed down to the femur, six inches below the trochanters, and taking a direction upwards on the outer side of that bone, denuded it entirely of the periosteum for the distance of three or four inches, and was cut out from beneath the gluteus maximus muscle of the same side. Here the first symptoms manifesting an attack of this dreadful disease was violent spasmodic action of the muscles of the injured limb, which soon extended to those of the whole body, followed by trismus, and a certain degree of opisthotonos. He expired on the fifteenth day after receiving his wound, and nine days after being received from the Mexican hospital; having been taken prisoner and carried thither on the 21st of September, the day on which he was wounded.

* * * * *

“While on the subject of wounds, and in connection with them, I will here recall your notice to a circumstance which proved extremely annoying at the time, and, in some instances, of fatal consequence to the patient, which I have described in my former communication. I allude to the myriads of maggots that infested every wound dressed on the field, and which in an incredibly short period from the time of deposit of the ova of the fly were burrowing and nestling in every part of it, requiring the greatest labor and perseverance to effect their complete expulsion, and which in some cases was impossible. I little imagined at that time that these formidable insects would actually invade during sleep the nasal passages and the mouth, and deposit their ova. Such has occurred recently here in two cases which fell under my observation. I shall report them now, more from their singularity than any practical benefit which can possibly be derived from a notice of them.

“Case 2d.—Carpenter, a private of a company of Texan Rangers, was removed from the field hospital in camp to the general

hospital in town, in consequence of repeated epistaxis or hemorrhage from the nose, which had occurred for several successive days, and was arrested with great difficulty at each time. His features were greatly swollen, with inflammation of the nose and adjacent parts. The man complained at the time of irritation, and something, as he described, moving in his nostrils. These, on examination, appeared to be closed up, and the source of irritation revealed itself by the discovery of a large quantity of maggots, of a large size, filling each cavity and manifesting the greatest activity. On inquiry into the history of the case, I found that this man had, some days previous, after sleeping soundly during the day under the shade of a tree, been seized shortly afterwards by tickling and irritation in the nostrils, followed by inflammation and swelling of the nose internally and externally; and subsequently, when ulceration took place, by hemorrhage. The first object in the treatment of the case was of course the expulsion of the worms, which were evidently the source, as well as the continuance, of the mischief. With this view, calomel was blown through a quill far into each nostril, and afterwards spirits of turpentine freely applied by means of a feather immersed into it, and introduced as far as possible. These applications had the effect of bringing away a great number, which relieved him considerably; but the irritation caused by the *ol. terebinth* obliged us to discontinue it. I then substituted a strong decoction of quassia injected frequently into each nostril, which had the effect of bringing away between 200 and 300 of these worms in one day, and, in the course of two or three days more, effected their complete expulsion, and discharged the man entirely cured. The other case was that of a teamster in the employ of the quartermasters. He, as in the former case, was brought from camp, and received into the hospital appropriated for the sick of that department of the army. His was of a much more grave and serious character than the former. On examination, the *velum pend. palat.* was discovered in a high state of inflammation and infiltration, resting on the tongue and completely closing the entrance of the fauces. The inflammation also extended to the parotid and sublingual glands, accompanied by a most fetid and offensive discharge both from the mouth and nostrils. Before his entrance into the hospital he had discharged many worms. I subse-

quently ascertained he vomited and discharged by stool many more; the last, however, were all dead, and were described as of a different color (being red) from those discharged from the nostrils, and which continued until his death, some four or five days afterwards. In this miserable and loathsome condition, he was unable to speak or swallow. The history of his case was very similar to the former. He was represented as frequently sleeping during the day under the shade of some trees, and while in this condition was extremely difficult to rouse. They, moreover, described him as partially idiotic or foolish; and the supposition was that while in a state of deep and profound sleep with his mouth wide open, the fly or flies actually entered and deposited their ova. The question may arise as to whether ulceration existed before the appearance of the worms, and which by the fetid character of the discharge would naturally attract the fly, and form a fitting nidus for their eggs. Not having seen the commencement of these cases, I cannot positively assert the existence or non-existence of this state of things; but so far as I can learn from the history of both, would seem to favor the idea or belief that the fly or its larva was the original source of the mischief and disease.''

* * * * *

In contrast to modern methods, it is interesting to note from the above extracts that major operations (amputations) were performed on the field while under direct fire. In the World War such surgical procedures were withheld until the patient had been transported to hospitals in the rear.

The references to gangrene and to infection of wounds by maggots are also interesting.

The organization for the collection of the sick and wounded did not differ materially from that used in the latter part of the Revolutionary War or the War of 1812. Nothing of any moment was contributed by this war in the way of new or improved methods for the care and treatment of casualties.

Duncan gives the following losses in the Mexican War:

Killed and died of wounds.....	1,549
Died of disease.....	10,951
Discharged for disability	13,825

These figures make an interesting comparison with the losses sustained in the World War in which the losses from disease were practically equal to those from wounds. However, it must be remembered that there was practically no knowledge at that time of the infectious diseases and their spread and control. The lack of proper clothing and other supplies is harder to explain.

The sick rate from dysentery was high and the disease was spread widely through the home country by the returning troops.

Through the Mexican War, the United States acquired a tremendous strip of valuable territory including Texas and California for which \$15,000,000 was paid by the government. The army gained retirement for officers, military rank for medical officers, and the Soldiers' Home. The lesson of unpreparedness was not taken to heart, however, and we entered the Civil War again totally unready.

The Civil War

When the war began, there was no organized ambulance or field hospital service, and no organization for the collection of the wounded on the field and their evacuation to hospitals in the rear. Hospitals were hastily improvised in hotels, barns, and near-by private houses. The introduction of rifled arms had immensely increased the range of rifle fire and the fixed ammunition had vastly increased the rapidity of fire. Wounded were scattered widely over the field, rendering aid to them a much more difficult matter. In the early days wounded lay on the battlefield for many hours and frequently for days before they were evacuated to the rear. This of course complicated the chances for their recovery to a decided degree.

Duncan relates that, on two occasions, evacuation to Washington was attempted by commandeering 100 rickety hacks and hucksters' wagons from that city. There was, therefore, no effective way of getting the wounded from the firing line to hospitals in the interior in reasonable comfort or in a reasonable time. The effect upon morale was bound to be very bad.

Jonathan Letterman became medical director of the Army of the Potomac on June 19, 1862. He immediately began to prepare plans for an adequate system of evacuation, and on August

2, 1862, his plan for an Ambulance Corps was put into effect by McClellan and later by other commanders. From this time on evacuation from the front steadily improved and Letterman's plan was incorporated by Congress in the Act of March 11, 1865. To Letterman, therefore, goes the credit not only for developing the principles which solved evacuation for the period of the Civil War but also for laying down the principles which have formed the foundation for the system of evacuation in use to-day.

Letterman's work included three great improvements in methods of evacuation, which may be described briefly as follows:

(a) *Ambulance Corps.*

This provided for an ambulance corps for each army corps. Two-horse vehicles with two litters each were provided in the proportion of 3 for each regiment of 500. The personnel consisted of a captain as commandant, with one lieutenant for each division or brigade, one sergeant for each regiment, two privates and one driver for each ambulance, and one driver to each medicine wagon. The personnel was under the control of the medical director, and use of the ambulances for any purpose other than evacuation was forbidden. This was a tremendous step in advance. The system was first tried out at Antietam (September 17, 1863), and demonstrated its worth though beset with many difficulties in the way of securing ambulances, equipment, and supplies.

(b) *Supplies.*

Prior to this time, supplies had been distributed by a regimental system. This system had not worked well and there was either an excess or an actual shortage, resulting in either suffering from a lack of supplies or reckless waste when their bulk made them difficult to transport. In his supply table of October 4, 1862, Letterman inaugurated an economic selection of the amounts of different medicines and equipment to be transported. He thus reduced the number of supply wagons by nearly one-half.

(c) *Mobile Field Hospitals.*

Under the old system, there were stationary regimental (tent) hospitals, and base hospitals improvised in large buildings in

interior towns. Letterman's *Circular* of October 30, 1862, introduced the mobile field hospital. This consisted of tents and equipment, with appropriate medical and surgical personnel, for receiving and treating the wounded prior to their evacuation to base hospitals in the rear.

This completed the system and was the greatest advance made up to that time in the orderly collection, early treatment, and evacuation of the wounded.

The first ambulances furnished in 1861 were light two-wheeled carts of the Larrey type.

Baron Dominique-Jean Larrey (1766-1842) served with Napoleon in his various campaigns. He soon noted that, in consequence of the old 18th century rule of relieving the wounded only after a battle, transportation to base hospitals occupied a day or more.

Larrey decided that it was better to send the hospital to the patient and developed the celebrated "ambulances volantes" (1792). They were of two kinds—light, closed two-wheelers carrying two wounded men each, drawn by two horses, and heavier four-wheelers carrying four men and drawn by four horses. These wagons were fitted with removable litters and carried refreshments and bandaging materials.

The two-wheel carts were very uncomfortable and were soon replaced in the Civil War by capacious four-wheelers of varying types.

The base hospitals, both Union and Confederate, were at first located in hotels, factories, warehouses, schools, etc., to which were added additional wards as the wounded arrived in large numbers. Later, separate groups of wooden pavilions were constructed, similar to the cantonment hospitals erected in the World War.

The losses in the Civil War were as follows for the Union forces only:

Killed	67,058
Died from wounds	43,012
	<hr/>
	110,070
Died from disease	224,586
Died—unknown causes	24,942
	<hr/>
	359,598

This was far better than in the Mexican War, but it will be noted that deaths from disease were at least twice as great as deaths from wounds. Modern medicine with its exact knowledge of the methods of prevention of many of the infectious diseases had not yet come into its own.

The Army Medical Museum was founded August 1, 1862, as a result of the collection of pathological specimens, projectiles, etc., from the battlefield.

Another outstanding medical figure of the Civil War period was John Shaw Billings, a Regular Army surgeon, whose splendid work in so many fields was continued for almost fifty years after the close of the war. He is best known probably by his work in developing the Library of the Surgeon-General's Office in Washington, D. C. At the outbreak of the Civil War, this library consisted of about 1,000 volumes. Through the energy and splendid ability of Billings, it became the largest medical library in the world.

Aside from his being the greatest medical bibliographer of his time, Billings was marvelously versatile. He was an able operative surgeon during the Civil War, an authority on military medicine, public hygiene, sanitary engineering, statistics and hospital construction, the author of a critical account of American medical literature (1876) and of the history of surgery (1895). After his retirement from the Army in 1895, he became for a short period professor of hygiene at the University of Pennsylvania. At the end of a year, however, he resigned to take up his duties as director of the New York Public Library in 1896. In this capacity he supervised the selection of the site, prepared the competition for the exterior, prepared with his own hands the plans of the interior arrangement of the building as it now exists, and served as its guiding spirit until his death in 1913.

Another monument to his genius is the Johns Hopkins Hospital, of which he was the designer. He also designed the Peter Bent Brigham Hospital in Boston as well as other modern hospitals.

From the above, it is seen that Billings did an enormous work for the advancement of American medicine. He was easily one of the greatest figures ever connected with the U. S. Army Medical Corps.

The Spanish-American War

Again we entered into a state of war in a totally unprepared state. This war occurred so recently that a detailed discussion appears to be unnecessary.

As a result of our unpreparedness and our inability to control the spread of certain diseases, especially typhoid fever, malaria and yellow fever, the death rate from disease was appallingly high. The record in this respect was worse than in any other American war of which we have reasonably accurate records except the Mexican.

A boon to humanity, however, resulted from the epoch-making investigations conducted by Major Walter Reed and his associates on the manner in which yellow fever is transmitted. This will be discussed later.

In this short and rather mild conflict, the following deaths occurred:

Killed and died from wounds.....	559
Died from disease	2907

The Surgeon-General during this period was the eminent General George M. Sternberg. Fully cognizant of the dangers incident to the mobilization of a considerable number of troops with the enrolment of a large number of additional medical officers without experience in the field, General Sternberg issued a circular four days after the declaration of war (April 25, 1898) which, if followed with reasonable thoroughness, would unquestionably have resulted in model camps and in minimizing such infectious diseases as typhoid, dysentery and malaria. But undisciplined and untrained troops, together with inexperienced medical officers, formed a combination bound to result in disaster, especially in the absence of the powerful preventive which we now have at our disposal, *i.e.*, typhoid-paratyphoid vaccine.

General Sternberg was undoubtedly one of the most scientific workers ever developed by the American Army.

He was the pioneer bacteriologist of the country. His contributions to the advancement of military medicine included the founding of the Army Medical School (1893), the establishment of bacteriological laboratories at the School and at posts, the development of a hospital for tuberculosis at Fort Bayard, New Mexico, and the creation of the Army Nursing Corps (1901).

The World War

Between the Spanish-American War and the World War great advances were made in the prevention of diseases peculiar to armies in the field so that, in spite of our state of unpreparedness on April 6, 1917, the Medical Department of the Army, reinforced by the brightest minds in the civilian profession, made a record of which it is justly proud.

In discussing the World War, advantage will be taken of the opportunity to discuss first in a general way the modern organization of the Medical Department of the Army and its many functions.

The functions of the Medical Department of the Army in time of war may be divided into six important groups which will be discussed in the following order:

1. Physical examination of recruits.
2. Prevention of disease.
3. Evacuation of sick and wounded.
4. Definitive treatment of sick and wounded.
5. Supply.
6. Records.

(1) *Physical Examination of Recruits.*

This is a most important duty for, upon it, depends the mental and physical character of the men who will defend the nation on the battlefield. It is exceedingly important that the mentally and physically unfit be discovered before entry into the service. Failure to do so means that such individuals will become casualties, in most instances, as soon as they reach the front and, in many instances, long before that time. They therefore are of no value as combat troops and, in addition, require the services of a large number of other individuals in order that they may be properly evacuated and adequately cared for. They also occupy hospital beds at a time when they may be needed badly for real battle casualties. Finally, they add greatly to the ultimate cost of the war by later becoming successful applicants for a pension on the ground that their disability was directly incident to their military service.

In the World War this duty was an enormous one, and an analysis of the data obtained discloses rather a startling state of affairs in the physical condition of the youth of the nation.

The following figures need little discussion. They are taken from the official publication, "Defects Found in Drafted Men," War Department, 1920.

Number of registrants enrolled	24,000,000
Number physically examined	5,719,152
Rejected by local boards	27.99%
Rejected by camp surgeons—these had been accepted previously by local boards	7.05%

After men had been examined and accepted by local boards, they were sent to the various camps where they were again examined and classified according to their physical condition by the camp surgeons. It will be noted that the camp surgeons rejected a considerable number of men who had been accepted previously by the local boards, totalling 7.05 per cent. of the whole number of registrants who were examined physically.

The classification of these registrants at camps gave the following results:

Total number from which these figures are deduced.....	1,961,692
Without defects—62%	1,221,388
Defective—38%	740,304

The defectives were further classified as follows:

Class A—defective but fit for any duty—29%.....	557,825
Class B—those having remediable defects—0%.....	538
Class C—fit for limited service only—2%.....	43,554
Class D—rejected—unfit for any duty—7%.....	138,387

Class B appears surprisingly small, but this is due to the fact that this classification was not put into effect until late in the war. Had it been adopted earlier, the percentage coming under it would have been much greater.

The startling fact disclosed by these figures is that 35 per cent. of the youth of the country were found physically unfit for

any form of military service. This means that, if the entire 24,000,000 registrants had been called into service, approximately 8,400,000 would have been rejected. It is reasonable to assume that the young women of the country are in no better mental and physical condition than the men and that there are, therefore, approximately 8,400,000 young women possessing serious mental and physical defects. That nearly 17,000,000 of our youth possess such serious defects is a matter that should give each one of us real concern. It is a matter that touches the future welfare of the country in a vital spot, for it is undoubtedly true that many of these defectives, though not fitted for marriage, will marry and will produce more defectives.

The first question that naturally arises is, what can be done to meet this rather disturbing situation? Several lines of action suggest themselves.

1. Careful physical examination, and appropriate treatment when indicated, of school children, for it is during these early years that defects can be corrected most successfully. To be of maximum value, such examination should be repeated at regular intervals and at least once a year. I know that much highly commendable work has been done along this line but much remains to be done.

2. Annual physical examination of all individuals. The Army has required an annual physical examination for the past 18 years or so of all officers and now includes warrant officers in the requirement. Nurses come in the category of officers. It has been a most useful procedure and serves to disclose serious defects at the earliest practicable moment. Many individuals are prone to disregard symptoms, hoping that they are not of serious import. In many instances no symptoms are noticed and, except for the annual examination, defects would be undiscovered until the condition had progressed to a degree that precluded permanent relief.

There has been considerable agitation in civil life recently along this line but little real progress appears to have been made. In the Army, it is a simple problem, for the promulgation of the necessary orders insures that the project will be faithfully executed. In civil life, the problem is vastly more difficult and can only be solved, I believe, by a process of progressive education.

3. Of course, the old question of the prevention of propagation on the part of certain classes of defectives comes up, but that is an extremely difficult problem to solve and one that I do not feel competent to discuss.

It is true that a certain proportion of the rejections noted above was for defects which, while rendering the individual unfit for military duty, would not prevent his leading a fairly normal and useful existence in civil life. To counterbalance this, however, it must be remembered that certain physical standards for military service were considerably lowered during the World War and that, therefore, numbers of men were accepted who would not be accepted during peace.

This was especially true in the case of venereal diseases. This is discussed in later paragraphs.

Requirements as to height and weight were reduced from the peace-time minimum standards of 64 inches in height and 120 pounds in weight, to 60 inches in height and 110 pounds in weight.

The general causes for rejection were :

	Per cent.
1. Conditions preventing free mobility	39
2. Defects of special senses	12
3. Cardio-vascular defects	10
4. Developmental defects	10
5. Nervous and mental defects	6
6. Venereal	5.7
7. Tuberculosis	5.3
8. Nose and throat	5
9. Skin and teeth	3
10. Respiratory other than tuberculosis	1
11. Others	3
	100

(2) *Prevention of disease.*

Here we enter a rich field, but, in the limited time available, we can only scratch the surface. A few of the outstanding accomplishments have been selected in order to illustrate this im-

portant phase of military work and to show the results which have been achieved.

(a) *Typhoid fever.*

In past wars, this disease has been a scourge of armies in the field. Every one remembers the distressing experience with it in 1898 and that of the British in the Boer War. In striking contrast, there was never a time during the World War that the problem gave any real concern.

In the World War there were 1,386 cases of typhoid fever with 215 deaths out of a total strength of 3,703,191.

In the Spanish-American conflict, there were 20,738 cases with 1,580 deaths out of a total strength of 108,000. (Keefer, "Military Hygiene," page 62.)

If the same rate had prevailed in the World War as in the Spanish-American, there would have been slightly over 700,000 cases with 70,000 deaths in the American forces alone. If such had been the case, the query naturally arises, how long could the war have lasted with such a staggering loss from illness?

In other words, one out of every five soldiers in the Spanish-American War was attacked with typhoid fever, while, in the World War, only one out of every 2,672 was thus attacked. It is interesting to note that 90 per cent. of all deaths among soldiers encamped in the United States in 1898 were from this disease.

It is quite evident to one who saw the conditions under which our troops lived in the A. E. F. that this remarkable achievement was due practically entirely to the typhoid-paratyphoid inoculation. There are some who might contend that improved sanitation had considerable effect upon the situation, but those who were in France realize, I am sure, that sanitary conditions in the trenches and, later, on the battlefields in the open warfare, were certainly as bad as could be found in any of the camps of 1898. Flies were present in distressing numbers especially during the Chateau-Thierry campaign and had free access to numerous sources of potential typhoid infection. Water supplies in France were notorious for their practically universal pollution, so that every factor was present for a widespread epidemic except the unprotected individual.

This certainly ranks as one of the most remarkable achievements ever recorded in preventive medicine, and it is particularly pleasing to the Regular Army, for the practical application of the method was the work of its medical department under the leadership of Colonel Frederick F. Russell. It is true that the Germans had done some work along this line and the English had also tried inoculation during the Boer War, but no real results were achieved until the United States Army developed the method and demonstrated its efficiency.

(b) *Tetanus.*

In 1914, in the English forces, 32 per cent. of the wounded were infected by tetanus. In 1917, only 0.1 per cent. were attacked.

In the American forces, there were 21 cases and 4 deaths between April 6, 1917 and December 31, 1919.

The soil of France and Belgium, intensively cultivated for centuries, formed a highly favorable medium for the development of the tetanus bacillus, and an exceedingly serious situation faced the warring forces. Fortunately, a remedy was at hand and, through the use of tetanus antitoxin, the remarkable reduction shown above was accomplished.

It became routine practice to inoculate every wounded man no matter how slight the injury might be, provided of course that the skin was broken. This was done at the farthest point forward that was practicable so that the time between the receipt of the wound and the inoculation was reduced to the minimum. It was usually given at the battalion aid station. In order that those in the rear, through whose hands the patient successively passed, might know that he had been protected, a T was placed on his forehead with an indelible pencil.

(c) *Smallpox.*

The prevention of smallpox is so familiar to everybody that no discussion is called for, but two illuminating instances in modern warfare of the efficacy of vaccination are worthy of mention.

In the Franco-Prussian war, the French lost 20,000 men from this cause. They were not protected by vaccination. Under

the same circumstances, the Germans, who were protected, lost only 297.

In the Russo-Japanese War, the Japanese forces had only 362 cases and 35 deaths out of an army of over 1,000,000, though smallpox was endemic in Japan at the time.

In the World War, between April 6, 1917 and December 31, 1919, the American army had 794 cases with only 5 deaths. The total of mean annual strengths for this period was 3,703,191. ("The Medical Department of the U. S. Army in the World War." Vol. XV, Part 2, Page 576.)

(d) *Yellow fever.*

The control of yellow fever represents one of the most remarkable achievements in the history of medicine. Formerly a terror of tropical and sub-tropical countries and occasionally stretching a devastating hand into northern climes, it has been securely bound and no longer represents a menace against either commerce or military operations.

This remarkable result has been attained through the work of military medical men led by Reed and Carroll of the Regular Army Medical Corps, with whom were associated Agramonte and the heroic Lazear, who sacrificed his life in demonstrating the fact that yellow fever is transmitted by the bite of an infected mosquito.

Time does not permit our going into the details of this epoch-making work. Suffice it to say that, as a result of their labors, we now have the means of completely banishing this dread disease.

It fell to the lot of another Regular Army medical officer, Major, later Major-General, William C. Gorgas, to apply practically the discovery of the Reed board. As a result of his brilliant efforts, Havana was freed of yellow fever for the first time in 150 years and has remained free ever since.

Transferring his activities to the Panama Canal, the application of the same methods rid this formerly pestilential district of yellow fever and so reduced the incidence of malaria that the Canal Zone became almost a health resort.

To illustrate what a triumph this has been, it may be of interest to note a few of the more striking outbreaks of this disease in former times.

1664—St. Lucia Island (West Indies)	...1,411 out of 1,500 soldiers died.
1665—“ “ “ “ “	... 200 out of 500 sailors died.
1666—“ “ “ “ “	entire population of 5,000 men, women, and children died.
1699—Philadelphia 220 deaths
1793—“ 10% of population died.
1853—New Orleans 29,020 cases with 8,101 deaths.
1878—Memphis 17,600 cases with 5,150 deaths.

New York was attacked in 1668, Boston in 1691 and again in 1693, and Philadelphia was also visited in 1695.

Between 1800 and 1879, the disease was present in the United States every year but two, though it was epidemic on only a few occasions.

No cases occurred in the American forces during the World War.

(e) *Plague.*

This disease which, in former times, caused the most frightful devastation throughout the world, has been brought under control by the knowledge that it is a disease of rats transmitted to human beings by the bite of infected fleas. While prevention therefore depends upon warfare against rats and fleas, it must be remembered that the pneumonic form is also carried by infected sputum.

While not peculiarly or particularly associated with military operations, it has scourged armies in the past, especially during the Thirty Years War. Some of its most striking outbreaks merit therefore a brief recital.

1348—It has been estimated that 60,000,000 deaths, or one-fourth of the population of the earth, resulted from a pandemic

of plague. After devastating Asia and Africa, it appeared in Europe. From a focus in the Crimea, it spread *via* Turkey, Greece and Italy north and west over the whole of the continent, again attacking it from a second focus by way of lower Austria.

1630—Milan	80,000 deaths
Venetian Republic	500,000 “
1665—London	69,000 “
1679—Vienna	70,000 “
1681—Prague	83,000 “

1892-1907—Plague has caused dreadful havoc in India since 1892. In 1907, over 1,000,000 persons died of this disease in that country. (Rosenau: “Preventive Medicine and Hygiene,” 1918, page 283.)

1894—An outbreak occurred in Hong Kong which, except for modern sanitary control, might easily have assumed pandemic proportions.

1907-8—Plague appeared in San Francisco. Denials were made at first that it was really plague. The United States Public Health Service was placed in charge of the situation, found plague actually existing but succeeded in stamping it out. Ground squirrels were found to be infected, and since that would require years of energy to control, California became at that time an endemic focus.

No cases occurred in the American forces during the World War.

(f) *Venereal disease.*

During peace, venereal disease is a cause for rejection for original enlistment in the United States Army.

During the World War, this was modified, the first regulations issued July 2, 1917, providing as follows:

“3. The following defects are causes for rejection:

* * *

“Syphilis when discernible by inspection and physical examination; tight urethral stricture; . . . Gonorrhoea, acute and chronic, is not disqualifying, but individuals should be advised immedi-

ately to secure appropriate medical treatment pending receipt of orders to report for duty.”

Regulations issued November 8, 1917, made further modifications and provided:

“Syphilis is a cause for rejection only when permanently incapacitating. Syphilis in the primary and secondary stages—that is, during the infectious period—chancroid and gonorrhea, acute and chronic, are not disqualifying, but individuals so affected should be advised immediately to secure appropriate medical treatment pending receipt of orders to report for duty.” (“The Medical Department of the U. S. Army in the World War.” Vol. V, page 470.)

This was a wise policy, for there is no reason why an individual should escape military service in time of war because of an infection of this sort. Our real concern should be to get him in as good shape as possible and then require him to do his part in the defense of the nation, being especially careful however to protect his comrades from accidental infection.

In comparison with previous wars, the record of the United States Army during the World War in the control of venereal diseases was a remarkable one. This was especially true in the A. E. F. While the actual work was done by the Medical Department, too much credit cannot be given for the results in France and Germany to the Commander-in-Chief, General Pershing, for his recognition from the start of the importance of the matter and for his unceasing and vigorous support of all measures of control that were instituted. It made the work possible. Without his firm support, the results would undoubtedly have been much less brilliant.

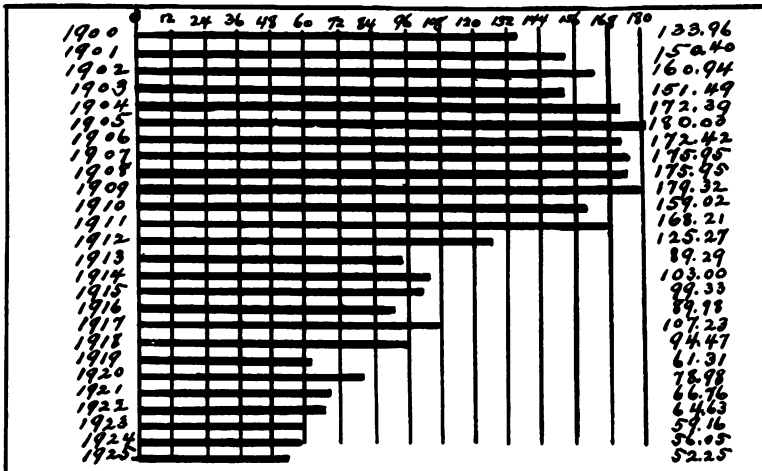
An analysis of the data obtained from official records shows not only that the Army had a splendid record in this respect but also how much cleaner the soldier was with regard to venereal diseases than the same age group in civil life.

The Army, with its control and discipline, can enforce the necessary measures. In civil life, control is very difficult and the problem is much more complex. Much public interest has been aroused and one sees a much freer discussion of this vital matter in the public press and in magazines, but a tremendous amount of work remains to be done if the nation is ever to become reasonably free from this loathsome form of infection.

In the Army, control was accomplished by periodical examinations, prophylaxis, and prompt segregation and treatment of all cases that were discovered. In addition, close coöperation with local health authorities aided materially in the discovery and control of those who might spread the disease. Prophylaxis was compulsory in the sense that if a soldier failed to avail himself of the protection thus afforded, he was subjected to court-martial. He also suffered loss of pay for the time lost from duty.

It seems to me that the control of venereal disease in civil life is one of the most important public health questions that we have to face. This is not the place in which to discuss the matter in detail, but one thought immediately asserts itself and that is, the pressing necessity for a compulsory physical examination of all individuals, male and female, who contemplate marriage. The burden of infection falls most heavily of course on the female, as a study of gynecological records will show. I have personally seen some distressing instances that would have been completely avoided if there had been a preliminary physical examination.

The following chart shows graphically the progress which has been made in the Army in the control of this class of infections. The active campaign for this purpose was inaugurated in 1909.



ANNUAL ADMISSION RATES FROM VENEREAL DISEASES PER 1,000 MALE MILITARY PERSONNEL YEARS 1900-1925.

It will be noted that a temporary rise occurred in 1917 and 1918 as the result of bringing into the military service a large number of cases which had been incurred while in civil life. In spite of this, the rate for 1918 was lower than for any previous year except 1913 and 1916, while the rate for 1919 was the lowest recorded up to that time. That the campaign is still securing results is shown by the fact that the rate for 1925 was the lowest yet recorded.

The most striking results in the A. E. F. were obtained in the 3rd Army in Germany. For a period of 27 weeks, from December 18, 1918, to June 25, 1919, the official records show an average rate of 19.04 per 1,000 per annum as compared with a rate of 61.31 for the entire Army for the year 1919. The 3rd Army went out of existence July 2, 1919.

(g) Death rates from disease and from injury.

As a result of the improved methods for the prevention of disease as briefly outlined in the foregoing, it is very gratifying to note the great decrease in deaths from disease in comparison with previous wars.

For the first time in our history, deaths from disease were held to a point where they were almost exactly level with deaths from injury. The official figures are:

Killed in action	36,694
Died from wounds	13,691
Deaths from non-battle injuries	5,591
	<hr/>
	55,976
Deaths from disease	56,176

The latter includes the many deaths from the pandemic of influenza and also those occurring in the large number of men who never left this country and who, therefore, were not exposed to the danger of death from battle injury.

If we consider only the troops who actually served in the A. E. F., we find the significant fact that, for the first time in our history, deaths from injury far exceeded deaths from disease. It seems to me that this is a fair comparison for the reason

stated above, that the troops in the United States while exposed to all the dangers from infectious disease ran no risk of battle injury.

For the A. E. F. only, therefore, we find :

Deaths from injury	53,065
Deaths from disease	16,695

That the record would have been much more remarkable if we had been engaged in the war for a longer period is evident from a study of French records which show the following :

Deaths from injuries	1,150,000
Deaths from disease	175,000

Could anything show more vividly the progress that has been made in the prevention of disease ?

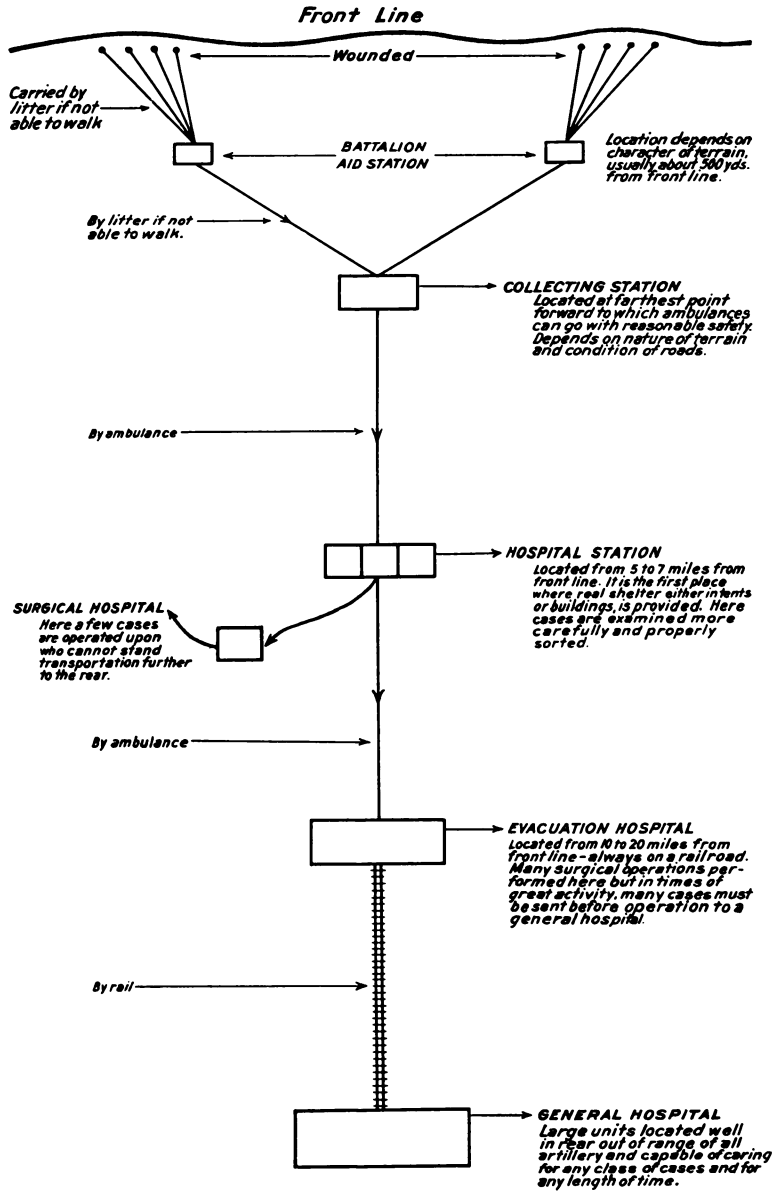
There are of course other preventable diseases which it would be interesting and profitable to discuss, but enough have been given to illustrate the remarkable advances which have been made in recent years.

(3) *Evacuation of sick and wounded.*

The following sketch shows the present organization for the evacuation of sick and wounded from the firing line back to the general hospitals. The latter units are similar to large civil hospitals and are so organized, equipped, and supplied as to be able to give adequate care and treatment to all classes of cases.

(4) *Definitive care of sick and wounded.*

Professional care of a soldier who becomes a casualty on the battlefield begins as soon as he falls into the hands of the medical department representatives who search the field for wounded. Naturally, however, treatment in the field and during evacuation must be confined to first aid until the patient arrives at an evacuation hospital. Here many operations are performed but prolonged treatment can be furnished only by organizations in the Zone of the Interior, far removed from the noise and stress of combat, namely, in the general hospitals.



It is not necessary to enter into a discussion of these units for they do not differ essentially from large civil hospitals.

(5) *Supply.*

This highly important branch of the medical service was splendidly conducted during the World War. From a wide personal experience, I can say that I never saw a time at the front when the wounded suffered from the lack of any essential element of supply.

Without reasonably adequate supplies it would be impossible to prevent unnecessary suffering, so that efficient functioning of the medical department will always depend very materially upon an efficient system of supply.

The subject is so large that it would be impossible to include a discussion which would be in any way comprehensive, so that we will content ourselves with a description of the system used at the front to prevent depletion of dressings and other essential items.

In order that a steady stream of supplies might be kept going to the front based upon actual needs, a system of exchange was inaugurated. For example, when an ambulance arrived at an evacuation hospital, there was returned to that ambulance a duplicate of everything that it had brought with it in the way of supplies. If it had four litters, eight blankets, and two Thomas splints, the same number of each was returned to the ambulance. In addition, if they required any other supplies or equipment, they were furnished on request. In this way, a constant, steady stream was always going toward the front. If it had not been for this method, there would inevitably have been times when the front line would have been out of some essential element. It was a simple system but it worked admirably. During times of stress, it was customary to send forward more than the ambulances brought with them in order to insure an adequate amount at the front when the need was unusually great.

(6) *Records.*

To many civilians coming into the military service, paper work was an unpleasant task. However, it is vitally necessary that

these records be kept for the protection of both the individual and the Government. Not only do they become of immense value for study and deduction after the war, but they are also of great importance in the establishment or denial of claims for pensions, for every wounded or sick soldier is a potential pensioner.

Justice demands that the individual be compensated for any injury sustained in line of duty by reason of his military service, but it also demands that the Government be not burdened with pensions in those cases where the disability arose prior to entry into service or where it resulted from the individual's own misconduct. Careful records are necessary to establish this fact.

Careful records are also necessary to insure that the soldier is properly paid and for various other purposes.

It is likewise important that a running record of treatment be kept for each patient from the time he is picked up on the battlefield until he reaches a general hospital. A simple field card is provided for this purpose. If this record is not kept, there is no way in which organizations in the rear may know what treatment has been administered at points farther forward, so that omissions and duplications of necessary treatment will be bound to occur.

With the foregoing rather sketchy discussion of an immense subject, we will close with the remark that the medical profession in general is justified in looking back with pardonable pride on what was accomplished during the recent conflict in the way of conserving the health and lives of those entrusted to their care.

As a result of this great experience, the country has a large body of medical men trained in actual warfare and therefore thoroughly competent to carry on in any emergency. Their numbers will steadily decrease with the passage of time but, through the agency of the Medical Reserve Corps, we now have a means of passing on to our younger brethren the lessons learned from our experience. Let us consecrate ourselves to this work, for in it lies the hope for the conservation of the man-power of the nation in any future conflict.