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NOTES ON MILITARY SURGERY

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(From the service of Lakeside Unit, American Ambulance, Neuilly-sur-Seine, Paris, France)

At the outbreak of the war a group of Americans in Paris, aided and encouraged by our able American Ambassador, mobilized the resources at hand and with surpassing dispatch organized a most efficient hospital of 450 beds. In general it may be said that probably never before in the history of hospitals has one been governed by an organization of such talent and such deep consecration as is found in this group of business, professional, literary, artistic, diplomatic men and women. I cannot sufficiently express my admiration for the achievement of this group of individuals in so efficiently expressing their sympathy for the injured soldier. The hospital was organized under the charter of the established American Hospital of Paris, and is known as the "Section for the Wounded." The hospital is located in Neuilly, a suburb of Paris, in a beautiful new building intended for a high school. The organization is efficient, the management excellent, the cuisine under Frascatti, and the personnel talented and cosmopolitan.

The American Ambulance is under the direct control of the War Department, of which Dr. Winchester Du Bouchet, the Surgeon-in-Chief, is the direct representative. There are four services, three of one hundred beds each, under Dr. Du Bouchet, Dr. Joseph A. Blake and Dr. Mignot, and the University Service of one hundred and fifty beds. In the course of discussions of the problems of the American Ambulance it was suggested that it would be to the mutual advantage of American surgery and of the American Ambulance, if certain of the teaching Universities were to form units to take charge of one division of the American Ambulance for a period of three months each. To a letter from Dr. Joseph A. Blake favorable response was made by Harvard University, the University of Pennsylvania, Chicago University, Western Re-

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serve University, and other universities are giving it consideration. It was the desire that each university should finance its unit, and that each unit should consist of a sufficient number of surgeons and nurses to carry on the work of the operating room, and the surgical care of the patients in the wards. The nursing care of the wards was assumed by the American Ambulance. The Medical Board, according to Dr. Blake's letter, felt that in this way a considerable group of American surgeons would become familiar with military surgery, and in turn would disseminate their knowledge so that a more intelligent conception of this branch of surgery would in some measure prepare us for possible need in our own country. It was not intended that the universities should assume any unneutral position, any more than surgery or science is unneutral. It was believed also that by this means the interest of the participating universities would be kept more closely in touch with the relief problems of the war. Furthermore, it was hoped that this action on the part of the universities would stimulate in the cities in which they are located a personal interest in the American Ambulance.

The Medical Board of the American Ambulance set apart the entire third floor of the hospital for the University Unit. This comprised nineteen wards of eight beds each, and two large, well-lighted rooms for an operating room and research laboratory. These two rooms were originally designed for draughting rooms and so had a northern exposure and were provided with skylights. It will be seen therefore that the management and the Medical Board of the American Ambulance were exceedingly generous in putting at the disposal of the American University so large, commodious and well-equipped a service.

I must add here that from the beginning to the end of the service of the Lakeside Unit of Western Reserve University the greatest courtesy and helpfulness were manifested by the management, by the Ambulance and by its Medical Board.

Under the management of Dr. Gros the Ambulance Department itself has rendered extremely efficient service. The ambulances of the American Hospital operated all along the line up through northern France into Belgium—wherever their services were most required. At the conclusion of my service I had the opportunity of paying a visit to the principal ambulance stations in France and Belgium. Everywhere I found that the ambulances were kept in splendid condition, and were operated most efficiently, the drivers being for the most part Americans—college men, polo players, hunters, and soldiers of fortune. Thus far there have been no fatalities among the ambulance men,

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although there have been several narrow escapes, especially during the recent aerial bombardment of the railway station at Dunkerque when some damage was done to several of the ambulances, but the men were uninjured.

Nursing.—The professional nurses of the American Ambulance were efficient and their personnel was most cosmopolitan. Sixty-three hospitals and thirteen nationalities have had representatives in the nursing corps. The heads of the wards and departments were professional nurses; these were assisted by volunteer auxiliary nurses, among whom were artists, authors, actresses and social leaders. Those auxiliary nurses who had been on duty since the ambulance opened had obtained a high degree of efficiency. They were punctual, obedient and devoted to their work, and many of them have become extremely proficient.

Orderlies.—The orderlies were volunteers also. Aiding them there were students, artists, authors, singers and noblemen. In one of our wards an orderly—a count—routinely had mounted in gold the bullets and shrapnel surgically removed from the soldiers. The personnel of this hospital is practically the same as in the hospitals of all of the warring nations, but it so happens that in the American Ambulance there is an unusual concentration of talent in all its departments. It certainly was not without surprise that one found among the orderlies in a ward men who had made great names as painters, sculptors, authors, or who held high positions in financial and political life.

Management.—In its efficiency the management could bear comparison with the best institutions anywhere. The cost of maintenance is lower than that in a hospital of equal efficiency under normal conditions.

The Lakeside Unit.—The Lakeside Unit consisted of a chief and four members of the graded surgical staff of the Lakeside Hospital who were residents in the American Ambulance under the same conditions and the same organization as when on duty in the Lakeside Hospital, a neurologist, an internist, two anæsthetists, two operating room nurses, and two research workers.

The first feature of the service to impress one coming from civil practice was that only able-bodied young men were seen as patients. We had in our wards not only French soldiers, but Turcos also, and some English. The soldiers exhibited a splendid morale, rarely complained no matter how severe their lesions; they showed marked resistance to infection and exhibited a high power of repair. I was quite unprepared to find the French soldier so stolid.

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Immediately after arrival the University Unit received from ten to thirty-nine patients every day, until the service of one hundred and fifty beds was filled. For the most part the patients were admitted at night. Normally from five to ten operations a day were performed. As compared with the work in civil practice, these operations were far simpler in technic, the outstanding difficulty, as pointed out by Dr. Blake, being judgment regarding the proper procedure in the more severe infections. I believe I have never known more difficult problems in infection than those presented in this service.

Anæsthetics.—Many operations being relatively short and performed upon very sick patients—exhausted, exsanguinated, extremely septic—nitrous oxide-oxygen proved to be the ideal anæsthetic. We took with us a supply of this anæsthetic and two anæsthetists skilled in its use and administration. Its great advantages were at once so apparent that our anæsthetists and supply of gas were utilized by the other services, especially in critical cases. Our anæsthetists found that the French soldier presented a different problem than the average civilian patient in this country, in this respect, that while the stage of induction was longer and more difficult, after the induction was completed, they required a relatively smaller amount of the anæsthetic and it was easier to maintain a smooth and even anæsthesia. A similar difficult induction in our patients at home would indicate a certain amount of alcoholism. It is probable that the more common use of alcohol among the Europeans would account for the generally greater difficulty in anæsthetizing patients. This difficulty is notably manifested in the use of ether. The French patients responded quickly at the close of the operation and many of them were able to walk back immediately to their wards. During anæsthesia, especially during its induction, the patients would frequently experience exciting dreams of battle.

The most interesting operation performed during our service was performed by my associate, Dr. Wm. E. Lower, who successfully removed a bullet from the pericardium.

Infections.—The greatest outstanding problem in the surgery in a base hospital is that of infections. Almost every wound was infected. Despite the perfection in technic in aseptic surgery in civil practice, in military surgery asepsis has failed. Antiseptics have failed. The type of infection depends in a measure on the type of injury, on the state of the soldier, and on the length of interval before the wound receives adequate treatment (Fig. 1).

Much of the soil of France and Belgium for generations has been under a high degree of cultivation involving the use of much manure,

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which is laden with gasogenic bacteria, such as tetanus and the Welch bacilli, which cause gas gangrene.

As the military operations of the present war are carried on almost wholly in trenches the clothing and skin of the soldier become laden with these germs, which the ball or shrapnel carries into the tissue. The type of wound has an important bearing upon the question of infections. Rifle balls usually make clean-cut wounds, only occasionally carrying clothing into them. Shrapnel and shell very commonly carry clothing into the wound—the highly infective clothing being a dangerous factor. In addition, the injuries from shell or shrapnel differ locally from a rifle injury in the following respect: The former produces a larger zone of contused and particularly devitalized tissue, which has a low resistance to infection. Most cases of gas gangrene follow shrapnel and shell wounds. Hence surgeons are now promptly treating these wounds by clearing out foreign bodies, excising the devitalizing tissue, and providing good drainage.

As to the treatment of wounds when once infected, I gathered from the leading surgeons in the British and the French armies that there has been no material progress made since the Franco-Prussian war. It has been said that the discovery of an efficient antiseptic would be worth 20,000 soldiers to the French army. As I have stated already, asepsis has failed; antiseptics have failed. Therefore, as pointed out by Sir Berkeley Moynihan, along this line the surgeon must begin his work afresh. Sir Almroth Wright and his staff at Boulogne are engaged in important researches, and progress is being made by them in combating infections, and doubtless there are extensive researches in progress elsewhere.

Under the auspices of the Rockefeller Institute, Alexis Carrel has gathered together a strong research group, including Dr. Dakin, who are to conduct a research into infections in a hospital near the line at Compiègne. This move is strongly seconded by Professor Tuffier. It is the belief that some new means of chemically controlling infection must be found. Sir Almroth Wright and Sir Berkeley Moynihan have pointed out the shortcomings of dry dressings which, by holding the products of infection close upon the wound, form a pus poultice. This pus poultice not only interferes with wound healing, but causes the absorption of poisonous enzymes. These observers advise warm moist dressings, immersion in hypertonic solutions of potassium citrate and sodium chloride, and, in severe knee or thigh injuries, the immersion of the patient in a bath. In our University division at the American Ambulance we tried the open-air treatment, after a certain

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stage was reached, and apparently secured better results than with dressings. The exposure of wounds to the electric light is especially advocated by Dr. Du Bouchet. Hot packs, immersions in hot water, free incisions, good drainage, physiologic rest, seem up to this time to constitute the best treatment.

Gas Gangrene.—Gas gangrene has been studied by Professor Weinberg, of the Pasteur Institute, and Dr. Jablons, Pathologist of the American Ambulance. Beyond a note by Weinberg these researches have not been published. One point seems quite clear, that is, that in many wounds many tetanus and gas bacilli may be found and yet neither tetanus nor gas gangrene may develop.

The clinical phenomena—*viz.*, fever, rapid pulse, increased respiration, sweating, delirium, unconsciousness and death—and certain researches in my laboratory in association with Dr. Austin and Dr. Hitchings on the effect on the kinetic system of toxins and infections lead me to the opinion that death from gas gangrene is caused by structural injury of the brain, the adrenals and the liver. The odor of these cases is apparently that of indol and skatol, and in my laboratory we have shown that indol and skatol cause identical lesions of the brain, the adrenals, and the liver. No specific treatment has yet been found. Hope is entertained that a serum made at the Pasteur Institute by Professor Weinberg may be useful. Continuous oxygen infusions in the tissues beyond the advancing margins is favored by some. Prompt amputation, leaving the stump wide open and applying peroxide of hydrogen, apparently yields the best results.

Very free incisions and heavy cauterizations are advocated by others, but the mastery of this disease is for the future.

Shock and Exhaustion.—Next to infection shock and exhaustion have probably killed the greatest number of soldiers. The emotional factor in many instances is a serious menace; for example, in the case of men distressed by being cut off from the main body of troops and of wounded men lying in the zone of rifle fire in the area between the first line trenches of the opposing sides, where wounded men may lie under fire until night and sometimes at night even cannot be rescued. In the fully-manned first line trenches, which extend well across the continent, there are always intense emotional activations during both day and night. The emotional strain is especially great when the opposing trenches are separated by only fifty yards or less and each is filled with brave resourceful men with splendid equipment for killing. In the early part of the war when the law of the survival of the fittest was relentlessly applied, many men in all the armies fell



FIG. 1.—Case of perforating shrapnel wound of right forearm with fracture of both bones and infection. (Service of Lakeside Unit, American Ambulance, Neuilly-sur-Seine, Paris, France.)

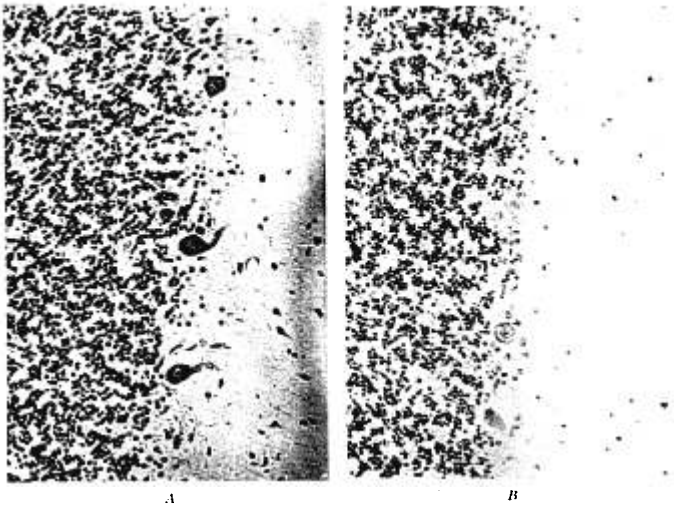


FIG. 2.—*A*, Section of normal cerebellum. *B*, Section of cerebellum of soldier who was wounded while fighting in the trenches in France. His wound was not dressed until about four hours later and it was four days before he reached the American Ambulance, where he died after an operation for resection of the fractured head of femur. He was without food for nine hours. This shows the disintegration of the Purkinje cells caused by the combined effects of emotion, exhaustion, loss of sleep, pain, infection and surgical shock.

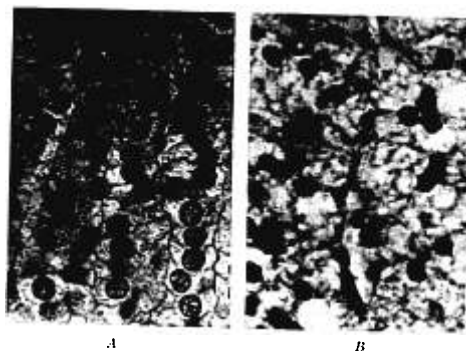


FIG. 3.—*A*. Section of normal adrenal. *B*. Section of adrenal of soldier described in preceding figure. The general disintegration of the cells, loss of cytoplasm, misshapen and eccentric nuclei illustrate the effect of emotion, exhaustion, lack of sleep, pain, infection, and surgical trauma.

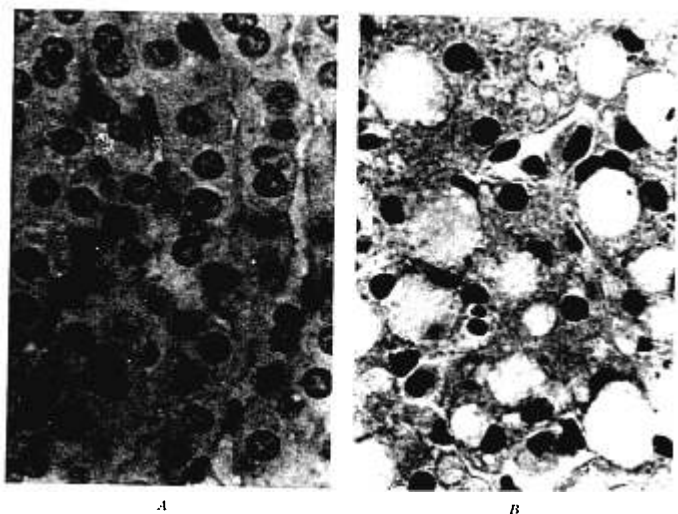


FIG. 4.—*A*. Section of normal liver. *B*. Section of liver of soldier described in former figure. The general disintegration of the cells, the loss of cytoplasm, and the vacuolated spaces within the cells illustrate the effect of emotion, exhaustion, lack of sleep, pain, infection and surgical trauma.

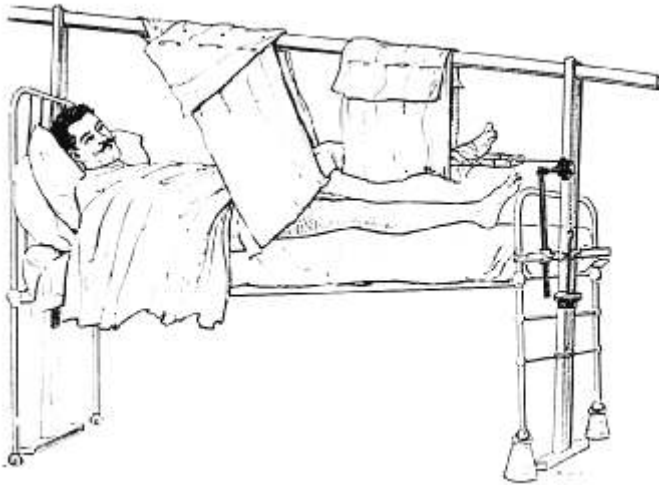


FIG. 5.—Balkan splint as used at the American Ambulance, Neuilly-sur-Seine, Paris, France.



FIG. 6.—Compound comminuted fracture of middle third of left humerus. Note the shattering and deletion of bone caused by a bursting shell. (Service of the Lakeside Unit, American Ambulance, Neuilly-sur-Seine, Paris, France.)



FIG. 7.—Lesion of external cutaneous nerve of thigh and of long saphenous nerve of leg, caused by rifle ball which entered just below right knee and emerged as shown. (Service of the Lakeside Unit, American Ambulance, Neuilly-sur-Seine, Paris, France.)



FIG. 8.—Frozen feet. (Service of the Lakeside Unit, American Ambulance, Neuilly-sur-Seine, Paris, France.)

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under the emotional strain. By the process of elimination and hardening the emotional strain is diminishing. There have been numerous examples of complete breakdown without any injury. There are innumerable cases in which very slight injuries have caused great shock—even death. As for the treatment of shock, under the almost inconceivable difficulties encountered in the larger engagements, the best that can be done is to give morphia. When from three to five thousand wounded must be cared for by a few surgeons only, it is idle to think of any treatment—many of the wounded cannot secure a drink of water, even (Figs. 2, 3 and 4).

Hemorrhage.—Secondary hemorrhages may occur, for the relief of which successful transfusions of blood have been made.

Transplantation of Limbs: Blood-vessel Suture.—The exigencies everywhere existing, the difficulty in controlling an absolute aseptic technic, have prevented thus far successful transplantation of limbs. But it is hoped that later on conditions may be so controlled that the transplantation of limbs and blood-vessel suture may have a fair trial. The most important blood-vessel surgery will probably come after the war.

Head.—Head injuries do very well at first, but later certain secondary changes develop, such as abscesses, and epilepsy.

In the hands of American dentists—especially in the American Ambulance—wounds of the jaws and mouth have been treated with remarkable success. This wonderfully successful work in oral sepsis, in transplantation of teeth, in fashioning dental splints, in fabricating sustaining bridges, and in overcoming defects is one of the excellent products of the war.

Chest.—Penetrating rifle wounds of the chest do very well. There is usually a quick convalescence and an early return to the front. In some instances, however, a pleurisy develops after the wound seems to have healed. On the other hand, in the case of penetrating shell and shrapnel wounds empyema nearly always develops.

Abdomen.—Penetrating wounds of the abdomen have baffled the surgeon. Even in the most skilful hands immediate operation usually ends fatally, death being due to shock and infection. Occasional cases recover with or without operation. I expect later to hear a more favorable report regarding these cases from the Belgian Field Hospital, which is situated near the front.

Pelvis.—Wounds involving the bladder or ureters with shattering of the pelvic bones usually end fatally. The struggle is prolonged but futile.

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Extremities.—High compound fractures of the thigh with great shattering of bone offer special difficulties; first the difficulty of transportation, then of shock and exhaustion, finally the inevitable infection. These cases call for the keenest judgment; for a decision to amputate depends upon the physical state of the patient, on the chances of transportation to a base hospital; on the length of time that will probably be spent in transit; on the probability of gas infection, on the equipment at the field hospital behind the line of battle, and on the ability and equipment of the surgeon in charge.

Shattering of the knee-joint presents a difficult problem, but these cases are more easily transported. Injuries of the leg and foot are easily supported for transportation. A shattered shoulder-joint, though far more amenable to treatment than the thigh, still presents much difficulty, especially when the infection spreads up over the shoulder to the neck, so that should gangrene occur the incision must pass through dangerously infected tissue.

The handling of vast numbers of compound fractures has brought out some new splints. Blake's splint is satisfactory, as it has the advantage of lightness, of simplicity, of giving excellent counter-pressure, of affording good room for dressings, and of admitting the free use of Buck's extension. Blake's splint also facilitates transportation and simplifies the taking of X-ray pictures.

Perhaps the most popular splint in the British service is the Balkan splint, one of the few useful products of the Balkan war. It is cheap, simple, can be made by anyone, can be used in many ways, and dispenses with coaptation splints and bandages. It consists of two wooden upright pieces at each end of the bed, the one at the head being higher; these two upright pieces support a ridge pole extending over the patient from the foot to the head of the bed. From this "ridge pole" the leg or arm is slung in slings, the extension apparatus being attached to the upright at the foot of the bed. By this means the limb is kept under extension and in an elevated position. This appliance gives the patient a large range of movement, gives the nurse good opportunity for work, permits dressings without movement, dispenses with splints or dressings, keeps off the weight of bed-coverings, and by the elevation of the limb swelling is minimized. We are introducing it into the wards of Lakeside Hospital (Fig. 5). Bone plating is used but little—but one surgeon is testing the value of the use of long Lane plates to facilitate transportation.

Repair of Infected Compound Comminuted Fractures.—After seeing the almost unfailing repair of widely shattered shafts of bone, the

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wounds filled with shrapnel and clothing, neglected and exposed, one must renew his faith in the reparative power of nature. I have the conviction that with time and patience any bone will repair itself even if the destruction be extensive and infection be present. Dr. Du Bouchet, Dr. Blake, and Dr. Mignot showed me some wonderful cases of extensive bone repair (Fig. 6).

Aneurisms.—True aneurisms are in the process of formation and will not be in evidence until nearly a year has elapsed. There are many false aneurisms, however. Those have been most successfully handled. Simple ligation is usually sufficient. In the University service we ligated the brachial artery, but took the precaution to compress it for hours at a stretch at frequent intervals in order to force a collateral circulation in advance of ligation. Before dissecting out the false aneurism we also assured ourselves as to the competency of the collateral circulation by Matas's test. The result was excellent.

Peripheral Nerves.—In a base hospital one finds many lesions of the peripheral nerves and some lesions of the spinal cord and brain. A base hospital should therefore have the services of a neurologist. Dr. C. W. Stone, the neurologist of the Lakeside Unit of Western Reserve University, found much interesting material (Fig. 7). We soon found that total "physiologic" cross lesions by no means indicated anatomical cross lesions. In fact one was surprised again and again by the escape of nerve trunks—apparently they are pushed aside by the missile. In one instance I isolated the nerve and found it not divided, but much swollen, obviously having been much contused. I isolated a distance of about two inches, fashioned a fascia-fat flap from the adjacent tissues, wrapped the fat side of the flap around the bruised, swollen musculospiral as a protecting sheath, and held it in place by several stitches. There was early restoration of function.

Pseudo-Frost-bites.—A large number of cases of so-called frost-bite were seen, especially in the earlier months. The weather in northern France and Belgium is quite mild as compared with the temperature in this region of the United States and it was soon apparent that the so-called frost-bite was not due to the cold alone, but that it occurred as a result of the combination of three factors, moderate cold, dampness and tight-fitting shoes and leggings. It was stated that no one of these three factors alone would have caused frost-bite, but that this lesion was the result of standing in water for a long stretch of time, while shrinking shoes and leggings interfered with the circulation, together with the moderate cold.

We found the best treatment was to keep the feet cool and dry by

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the application of stearate of zinc powder and exposure to the air. If gangrene had developed it was in most instances superficial. Though sloughing of the external parts was frequently observed, amputation was rarely necessary (Fig. 8).

Researches.—If this war has taught us anything it is that there is a most urgent need of research into the control of infections. As we cannot depend now upon Europe for this research, it becomes the clear duty and obligation of the profession in the United States to undertake it. It would be very desirable if the various civil laboratories and medical schools would take up this serious problem, especially with the point of view of discovering a chemical agent that will strike down infection after its initiation.

Conclusion.—In the early stages of the war when suddenly hundreds of thousands of wounded soldiers were flung hither and thither—and men untrained as surgeons had to acquire their experience at the expense of the soldier, the soldier not only had to pass through untrained hands, but these untrained hands had meagre facilities for their faltering work. This apparently is a part of the grist of the war mill. The army surgeon is relatively untrained in surgical practice, but he is highly trained in organization, transportation, emergency field work, all of which are of the utmost importance. On the other hand, although the civilian surgeon is untrained in military organization and transportation and field work, yet he is highly trained in the actual care of the patient. Obviously, therefore, the best results will be achieved by having the army service take charge of the field service and by placing the heavy surgical work of the base hospitals in charge of civilian units, and by having attached to each base hospital a board of consultants or inspectors composed of the most expert surgeons—practical surgeons upon whom can be placed the responsibility of the practical work and the formulation of general principles.

There are vastly important lessons to be learned from this war and a great service to be rendered. For the service it may render in the present and the good that may accrue to the future our country should not fail to avail itself of this opportunity.