The cream is made by adding the plaster little by little to a basin holding about a quart of cold water, the water being gently but continuously agitated with the hand as the plaster is added. When the consistency is such that the withdrawn hand appears to be covered with a white cotton glove, the correct combination has been made. The form is immediately plunged in the plaster bouillon as described above. Many ingenious forms are used, especially the Delbet *appareil de marche* for fractures of the leg. Upon the completion of all operative work and the healing of all wounds the patient is sent to a physiotherapeutic center. Here he receives massage, mechano-therapy, electricity, heat and gymnastic training. Following this, if unable to return to the Army, he enters a re-educational school where, with the assistance of many ingenious types of apparatus, he is taught to adapt himself to his physical incapacity, and after from three to six months enters once more into civil life.

DISCUSSION.

DR. DAVID CHEEVER, Boston: I was very much interested in what Dr. Clark had to say, especially about the guillotine amputations. That was the method used in the British army in 1915-1916, but I note that lately in the British surgical literature there have been many protests against this method. They necessitated secondary amputations, which resulted in marked additional shortening of the limb, and in a certain number of cases secondary tetanus appeared. Of course that could, no doubt, be handled by additional prophylactic injections of tetanus serum, so that the latent and encapsulated organisms freed by the secondary operation would be destroyed. It would seem that flap amputations, with the tissues held widely apart by appropriate packing with gauze and protective tissue, would be as effective in preventing gas bacillus infection and give better stumps.

DISCUSSION ON EMPYEMA AND ITS TREATMENT IN MILITARY CANTONMENTS DURING THE WINTER OF 1917-1918.

By MAJOR HOMER GAGE, M.R.C., WORCESTER, MASS.

IN response to the invitation of your committee, I am very glad to say a few words about one of the camp problems that has both-

ered us all winter, and that is really one of the most interesting and one of the most important problems that has arisen during the winter's work among the new recruits.

Our problems are quite different from those encountered in the camps in 1898, a difference largely due to the elimination of typhoid fever and the so-called "typhoid malaria." The absence of these diseases is due chiefly to the triple inoculation with typhoid and paratyphoid vaccines; but the splendid work of the Medical Corps of the Army in improving camp sanitation, in the careful selection of camp sites, with reference to their natural soils and drainage, and eliminating the sources of malaria and other insect-borne diseases, has been an important contributing factor.

In spite of all possible care, the herding together in barrack life of large numbers of men, especially from the country districts, has favored the spread of certain other infections. To a lesser degree we have scarlet fever and diphtheria; to a greater degree mumps and cerebrospinal meningitis, although we have been very fortunate in having little of the latter in New England. And to a still greater degree we have had measles and pneumonia, which have taken the place to a considerable extent of typhoid and its allied diseases, as the most common and the most dangerous diseases incident to camp life. They are always present in our base hospitals in larger proportion than one sees in our civil hospitals; and at periods of great activity, as after the arrival of large numbers of new recruits, constitute a clinic the value of which cannot be appreciated by those not in the service. The clinic thus constituted is an exceedingly valuable post-graduate course for the general practitioner.

From a surgical point of view, the most interesting thing in connection with the epidemic of pneumonia and measles has been the study of the empyema with which they have been so frequently complicated. In our experience about twenty per cent. of all cases of pneumonia have been followed by empyema, fifteen per cent. of the straight lobar pneumonias, and twenty-one per cent. of the post-measles pneumonias. The empyema met with has been very different from the type which we have been accustomed to see in civil practice and in our local hospitals.

Ordinarily, if, after the crisis of the pneu-

monia, we have a subsequent rise in temperature, or when the temperature remains up after the crisis should have occurred, we begin to look out for the physical signs of empyema, and when this seems sufficiently evident we aspirate, and if we find thick, purulent fluid, the case is turned over to the surgeon. Except in older, neglected cases it is not often regarded as an emergency, but is operated on, as the fluid reaccumulates, often under general anesthesia, and usually with the resection of a rib. If the case is neglected or unsuspected, we get a picture of general sepsis with marked dyspnea from lung compression.

Now the empyema of camp life during the past winter has been very different. It is of rapid development; does not wait for the crisis; in some instances fluid being present within three or four days after the symptoms of the pneumonia. More rarely it appears without the preceding pneumonia. In eighty-one cases of pneumonia with empyema, fluid was found, in sixty per cent. within the first two weeks, and in most of these within the first week. In other words, it has usually appeared before the pneumonia has cleared up, thus adding very greatly to the danger and difficulties of surgical treatment. Then again the fluid has collected very rapidly and suddenly, often reaching large amounts within twenty-four hours.

Another feature that has distinguished these cases from those ordinarily met with has been the character of the fluid. In very few cases have we found frank pus. We get instead a cloudy, serous fluid with much fibrin, showing many leucocytes microscopically. The fluid is often so clear that it seems hardly necessary to drain.

I do not know what is the mortality of empyema in civil life, although I believe it to be higher than has been generally realized. However, I do not think it has been comparable to the mortality from empyema as experienced during the last winter in the different camps. In one it was eighty-four per cent., in others fifty-three per cent., fifty-seven per cent., and sixty-five per cent. In twenty-five different camps there was an average mortality of over thirty per cent. It is clear, therefore, that pneumonia and empyema have been very important factors in the mortality as well as the morbidity statistics of the army camps.

Bacteriologically, most of these cases have

shown hemolytic streptococcus, both in smear and culture; and this has been true even of the lobar pneumonia. Often a Type I or Type II pneumonia would be accompanied by a streptococcus empyema. In some, where the mortality has been very low, the streptococcus has been absent, but apparently it has been quite universal. We undertook one or two interesting experiments to see how prevalent it was among the officers. From the medical officers at the Base Hospital cultures from the throats showed that seventy-two per cent. carried the hemolytic streptococcus in their throats. Then we tried it among the nurses, and found that sixty per cent. of the nurses carried it. Then, as a check, we took the camp surgeons, including the regimental surgeons, and only five per cent. of them were streptococcus carriers. Yet, of course, the cases of pneumonia were all coming from the camp. There were no cases of the streptococcus pneumonia among the personnel of the hospital, in spite of the fact that seventy per cent. of us were carriers.

We believe that the empyema was simply a local manifestation of a blood infection, that is to say, it was but an expression of a general constitutional infection. We felt that only upon some such basis could we explain the presence of the infection in both pleurae at the same time, in the pericardium, and even in the peritoneum. To these we occasionally added joint infections so that we really had a polyserositis. Although the pericardium was often involved, the endocardium was seldom infected. I remember but one instance, a case that was apparently convalescent, but which terminated fatally. The patient was sitting up in bed about ten days after thoracotomy, talking with his father, apparently very well, when he was seized with a sudden dyspnea and cyanosis, and died within five minutes, as if from pulmonary embolus. Autopsy showed an organized clot on the side of the right auricle, partly detached, and blocking the auriculo-ventricular opening. A noticeable feature of the autopsy was the presence of multiple pulmonary abscesses, some of them very minute, some holding two or three cc. of pus. When these were at the periphery of the lung, it seemed possible that their rupture might have given rise to a direct contamination of the pleural cavity, perhaps even with the pneumothorax that was occasionally met with.

One other interesting point disclosed by

autopsy was the presence of a large collection of fluid, in a few of our cases, between the left lung and the pericardium. It was really a walled-off abscess lying between two layers of the pleura. In one instance we found three or four hundred cc. in this locality. If we could have located it ante mortem, it could have been drained, but we were unable to detect it, even with the assistance of the x-ray.

The clinical picture differs from ordinary empyema, chiefly in its early appearance as a complication of the pneumonic process. The patients are, therefore, as a rule, much sicker than we have been accustomed to see them. If they live long enough for resolution to take place, they present a picture not unlike that commonly seen in civil practice.

In establishing the diagnosis, aside from the ordinary physical signs, the x-ray is of great value, often indicating and locating the pneumonia even before the physical signs are clearly defined, and revealing the presence and progress of a pleural effusion. Chief reliance as to the presence of fluid must, however, be placed upon repeated tapping of the chest with a good-sized needle. Some of the patients have to be tapped many times. As soon as you suspect the fluid, tap, and then tap again, and keep it up until you are thoroughly satisfied. It apparently does not disturb the patients much, if carefully and properly done, and it leads to a much earlier diagnosis than you get in any other way.

As to the interesting problem of treatment, of course we have the alternatives of frequent repeated aspirations and of drainage, and drainage may be obtained with or without rib resection. Repeated aspiration in some camps has turned out pretty well. In a few of the camps too extensive operation seems to have raised the mortality. We aspirated frequently, but in presence of a streptococcus infection, as proved by smear and culture, or in the presence of frank pus, we operated, and we operated as early as either condition was established. As to the form of operation we felt, and still feel, that the patients were so very sick, that it was unwise to add any greater discomfort or shock than was absolutely necessary, and in all instances we did a simple thoracotomy under local anesthesia. In the adult, one can get a large drainage tube between the ribs, and secure such good drainage that rib resection would not seem to be called for.

As for irrigation, we did not irrigate except in cases where there was a foul odor to the fluid (and that happened only once), and in cases where there were large fibrin clots, which we could not remove without irrigation.

We had twenty-one cases in which we had pneumococcus infection alone. Of these, seven were operated on without any deaths, and of the fourteen not operated, eleven died. There were forty-one cases with the streptococcus alone, twenty-six of which were operated on, with, up to the present time, eight deaths, and fifteen not operated on with eleven deaths. The infection was a mixed streptococcus and pneumococcus in five operative cases without a death, and in eight cases not operated on, of which four died. Of the cases in which the infection was unknown, or not recorded there were four, all operated on, and one of them died. Out of twenty-four operative cases, there has been up to the present time a mortality of eighteen per cent., and of thirty-seven non-operative cases there was a mortality of seventy per cent.

To summarize: I think our experience illustrates very well the absolute importance and necessity of operation. Its value seems to have been clearly brought out in our group of cases, and my experience and observation of the results in other camps leads me to stick strongly to my opinion about the value of simple thoracotomy with local anesthesia, as against the excision of rib, believing that the less you do to a patient so sick, in getting relief from the immediate difficulty, the better the chance you give him to get well. The only change that I should make in a future series of cases would be to put them immediately upon irrigation with Carrel-Dakin solution.

DISCUSSION.

S. J. MILXTER, Maj. M.R.C.: These cases of pneumonia and empyema have been most interesting as well as most trying. I have had a chance to see them in the base hospitals, and also to go over the statistics and the figures as they come in from week to week in the office at Washington.

The first thing which strikes one is the apparent difference in the virulence of empyema in different localities. I do not think the difference in the mortality in different places is entirely due to differences in operations, although it has been found that the more exten-