

satisfactory results will do better than in the past if these principles are applied. The penetrating wounds of the knee joint which we tended before the war to approach with fear and trembling can now certainly be dealt with boldly and with greater certainty of complete success. Crushing injuries of the chest or the less common stab wounds with division of intercostal arteries will do well when treated more radically than in the past has been the custom. There need be no hesitation about freely opening a chest full of blood in order to suture a bleeding wound of the lung or to tie a divided intercostal under a good exposure. Such cases should do even better than wounds of war since the probability of infection from without is greatly less and the surgeon may confidently rely upon his ability to drain a small empyema, should it occur, with the knowledge that the lung has expanded freely and that the final result will be a great improvement over that which will occur if large accumulations are allowed to look after themselves.

It is perhaps proper to utter a word of caution in accepting the figures which we put out from these hospitals near the fighting line. It is probably true that, even though these men are fatigued and even war-worn, they are still in better physical condition than the average civilian of the modern world; that they show a higher degree of resistance, whether to infection or to the physical insults of operative surgery. It is quite impressive to observe the extent to which these fighting youngsters can be literally smashed to pieces without destroying either their courage or their ability to resist infection. On the other hand, it should be possible to surround the problems in civil life which approach those of war with greater niceties of aseptic technic than was for us possible, and it may be that these two factors will so nearly balance each other as to give substantially symmetrical results.

#### EMPYEMA.

BY HOMER GAGE, M.D., WORCESTER, MASS.

The army camps have during the past two years afforded a most unusual opportunity for the observation and study of empyema, and when the experience of them all has been tabulated and carefully analyzed, as it will be, we shall have a contribution to the literature of

the subject of unusual value. Even if it fails to settle some of the problems which we should like to see settled, it will furnish the largest amount of statistical material on empyema gathered under identical conditions during the same period by a large number of different observers, than has ever been made available to the profession.

There were during the mobilization two distinct groups of empyema, common to all the camps. One during the winter of 1917-18, following the epidemic of measles, and characterized by the presence of the hemolytic streptococcus; the second, in the autumn of 1918, following the epidemic of influenza, characterized by the presence of pneumococcus or streptococcus, or both. Both groups gave the impression to those who had them in charge of being quite different from the empyema which they had been in the habit of seeing in civil practice.

It is not easy to define this difference exactly, but it seemed to me that from the surgical standpoint the most striking difference was the opportunity to see the cases very early after the onset. I think in most of our metropolitan hospitals we see cases much later, when the other serious complications have been outlived and more or less resistance to the infection has been acquired. They are more like what we used to call thoroughly ripe abscesses than like acute spreading infections, and the problem as well as the prognosis is quite different. Then, too, the chronic empyemas of tubercular origin were not met with in the army hospitals.

The experience of the last four years in France and Belgium has added very much to our knowledge of chest injuries, widened very much the field of operative interference, and simplified its technique. From this experience we look forward confidently to a decided improvement in the treatment and results of thoracic injuries. It can hardly be said that our experience with empyema has given us equal confidence. There is nearly as much diversity of opinion as to the proper treatment as ever there was, and this diversity of opinion as expressed in the reports from the different camps is the strongest possible evidence that we have not yet evolved a perfectly satisfactory technique.

In a discussion of this subject before the Society at its annual meeting last year, after confessing my dissatisfaction with our results at

Camp Devens, I closed by saying,—“that in a future series I would immediately begin irrigation with Carrel-Dakin solution.”

Well, I have now tried that method and am still disappointed in my results. The mortality is still too high, and the time required for convalescence seems unnecessarily long. But, after all, a careful study of unsatisfactory results is quite necessary to progress, and I am therefore disposed to present mine without apology.

The cases occurring in the early part of 1918 have been very fully studied and admirably reported by Lieutenant Horace Gray, M.C., U.S.A., in the recent numbers of the *BOSTON MEDICAL AND SURGICAL JOURNAL*.

Although the cases which were observed as a sequel to the epidemic of influenza have not led us to any different conclusions, it seems worth while to compare these later cases with Lieutenant Gray's in order to make the record of empyemas at Camp Devens complete. The results as a whole are neither very bad nor very good. I shall refer to the earlier group of Lieutenant Gray as Group 1 and the later cases of last fall and winter as Group 2.

The total number of cases under observation was 77 and 61—138—as indicated by the following table:

TABLE I.

	GROUP 1			GROUP 2		
	No.	Deaths	%	No.	Deaths	%
Cases operated on ..	43	9	21	45	9	20
Cases not operated on	17	8	47	11	3	27
Undiagnosed until autopsy .....	17	17	100	5	5	100
TOTAL .....	77	34	44	61	17	28

It will be observed that the mortality in the operated cases is practically the same in the two series, or about 20%. In the unoperated cases of the second group we were fortunate in having a larger percentage that improved rapidly after simple aspiration, and a smaller percentage of cases so desperately ill with general septicemia that operation seemed inadvisable.

As we were particularly fortunate in our ability to secure permission for autopsies in these cases, it is believed that the above represents a full and accurate statement of all the empyemas occurring in camp during both epidemics. The incidence of empyema in the first group was 16%, or 77 cases out of 485 pneumonias; in the second group it was 61 cases out of about 2,000—the exact number of cases

has not been tabulated yet—or not far from 3%—a very marked difference.

TABLE II. TIME OF ONSET OF EMPYEMA.

	GROUP 1	GROUP 2
In 1st week .....	27	5
In 2nd week .....	19	1
In 3rd week .....	6	13
In 4th week .....	7	11
In 5th week .....	1	9
Beyond 6th week .....	0	17
TOTAL .....	77	56

Our first case of influenza was admitted to the hospital early in September, but the first case of empyema was not discovered until October 7. In 90% of the second group the diagnosis of empyema was not made until after the second week; while in the earlier hemolytic group 80% occurred within the first two weeks. The same contrast appears between the two groups in the cases reported from other camps and constitutes an essential difference in the character of the infection.

In one set of cases the effusion seemed to occur almost simultaneously with the signs of lung invasion, and was recognized early because we had an opportunity not often afforded in civil practice of seeing a large group from the very onset of infection.

That the more rapid development of the effusion in the first series is partly explained by the difference in the infecting agent is illustrated by the following table:

TABLE III. BACTERIOLOGY OF PLEURAL EFFUSION.

	GROUP 1		GROUP 2	
	No.	Died	No.	Died
<i>Pneumococcus alone</i>				
Operated cases .....	8	0	24	5
Non-operated cases .....	14	11	4	1
<i>Streptococcus alone</i>				
Operated cases .....	26	8	8	2
Non-operated cases .....	14	10	3	0
<i>Pneumococcus and Streptococcus</i>				
Operated cases .....	7	1	4	0
Non-operated cases .....	6	4	0	0
<i>Unknown</i>				
Operated cases .....	2	0	7	2
Non-operated cases .....	0	0	4	2
<i>Influenza Bacilli</i>				
Operated cases .....	0	0	2	0
Non-operated cases .....	0	0	0	0
TOTAL .....	77	34	56	12

It will be observed that among those cases in which the effusion appeared in the first two weeks of the disease, that is in Group 1, nearly 70% were characterized by the presence of the streptococcus, and only 28.5% by the presence of the pneumococcus; while in those in which the effusion did not appear until after the sec-

ond week, 50% were due to the pneumococcus alone, and only 26% to the streptococcus. This is, however, merely suggestive, and further study of the table shows such a variation in the severity of the same infections that we are again confronted with the unsolved problem of individual resistance and the varying virulence of the same organism under different conditions.

It will be observed that of the pneumococcus cases 50% were fatal in Group 1, and only 20% in Group 2, and nearly the same proportion prevails in the streptococcus cases. It is obvious that a more virulent type of both organisms was present in the first epidemic, and that such conflicting figures in small groups can afford no definite conclusion.

A study of the operations is more productive. Lieutenant Gray refers to the hesitancy of the surgical service to adopt early interference, and plainly indicates the feeling of the medical service that the presence of a positive culture of streptococcus, and even of pneumococcus, should determine an immediate operation.

The following table shows the difference between immediate and delayed operations:

TABLE IV. TIME OF OPERATION.

	GROUP 1		GROUP 2	
	No.	Died	No.	Died
On 1st day of empyema..	6	3	17	5
On 2nd day of empyema..	10	4	7	3
On 3rd day of empyema..	2	0	5	1
After 3rd day of empyema	25	2	16	0

The significance of this table lies in the fact that both groups show unmistakably that a heavier mortality follows hasty interference—a conclusion that was reached by the Empyema Commission at Camp Lee and seems to have been confirmed by the experience of every army camp from which reports have thus far been published. It is the one positive conclusion in regard to the treatment of empyema which can be drawn from the experience of the past year that seems likely to stand as a guide for future practice.

Preliminary aspiration, the character of the fluid, rapidity of re-accumulation, and the degree of mechanical interference with respiration are all important factors in determining the time for operation. The great thing is not to be in too much of a hurry. There are few conditions that call for the exercise of a sound surgical judgment more imperatively

than this. Each individual case must be carefully watched and studied with the aid of the clinician, the laboratory, and the roentgenologist. No hard and fast rule as to the exact day can be entertained, except that the first few days after the onset of the empyema are always to be avoided.

Unfortunately there is less unanimity about the kind of operation than about the time of it. As stated in the discussion of last June, our preference is still for the minimum amount of operative interference consistent with the establishment of free drainage; and for adults we still believe that a rapid thoracotomy under local anesthesia best fulfills these indications.

For the primary operation in acute cases this should be, we think, the procedure of choice. In about 60% of the cases that recovered, this was all that was necessary. In the remaining 40% a secondary costatectomy had to be done. I believe the second operation was due more to failure of our after treatment than to the inefficiency of the first. Our chief consideration must always be the saving of life. The shortening of the period of convalescence as well as the avoidance of a secondary operation must not outweigh the risk of a higher mortality.

The question of how long a discharging thoracotomy wound shall be allowed to drain before resorting to secondary interference is important. There should be immediate alleviation of symptoms such as dyspnoea, harassing cough, and high temperature. Recurrence or persistence of these or any of them demand careful clinical and x-ray study of the chest to determine the efficiency of the drainage.

In view of the splendid results of secondary costatectomy obtained by Major Sanders, my successor at the Base Hospital, I am satisfied that we waited too long. In a large number of cases, through a long incision he has resected portions of two ribs, left the wide opening into the pleura without suture, and immediately started Carrel-Dakin irrigation. The result has been a rapidly healing wound without any mortality.

By the earlier adoption of this method I believe we might have materially shortened the period of convalescence, which averaged in our series of cases something over 90 days or 3 months. In comparison with the length of hospital residence in civil life, it must be remembered that those men had to be kept until their

wounds were entirely healed and they were able to return to barracks life. They could not be treated and dressed as out-patients or at home.

In both groups the after treatment consisted in most of the cases in simple drainage. In several of the second group the Carrel-Dakin irrigation was instituted immediately after the operation, and in a large number of instances it was tried later in the hope of speeding up convalescence. Little advantage was observed in these cases in marked contrast to the rapid improvement which has followed the use of the Carrel-Dakin method after the free opening above referred to.

The question naturally suggests itself—Is this result due to the Dakin solution or to the wide incision? I cannot but feel that the return to the good old surgical principle of large openings contributes more to success than the irrigation. The more radical operation cannot displace thoracotomy as the primary procedure on account of the danger to life, but it can with advantage be undertaken as soon as the patient's general condition will permit if the local condition is not showing satisfactory progress.

A study of the autopsy findings in the fatal cases shows that in addition to the empyema there were present in three cases, general peritonitis; in 3, purulent pericarditis; in 2, an undrained encapsulated empyema; in 2, abscess of the lung; and in all the peribronchitis and bronchiectasis characteristic of influenza.

It seemed quite obvious that the purulent pleuritis was but one of the local manifestations of a general septicemia, having its origin in the air passages. Drainage of the pleural cavity does not remove the primary focus, nor does it eliminate the infection of the pericardium or peritoneum. These are all important factors in determining the ratio of mortality as well as in controlling to a very large degree the period of convalescence, and they can be removed or modified only by a natural or an artificially induced immunity.

The purely mechanical problem of establishing efficient drainage of the pleural cavity seems capable of solution in a variety of different ways, as well as any, we think, by the method already outlined; but the extent to which complications of lung abscess, pericarditis, and peritonitis are met with in any given group of cases will always have a more important bearing on

the results than the method used in removing the pus from the chest and preventing its reaccumulation. It is the unknown factor which makes a statistical study of this subject always interesting, often instructive, but usually very inaccurate and unconvincing.

#### EMPHYEMA IN CHILDREN, WITH SPECIAL REFERENCE TO DIAGNOSIS.

BY FRANK SPOONER CHURCHILL, M.D., BOSTON.

The war has unfortunately furnished ample opportunity for the study of empyema as it occurs in adult males, with a corresponding flood of literature thereon. Naturally, these articles have not dealt with the condition in infants and children, and in civil practice there have been no special studies on the subject at those ages. Nevertheless, in response to the invitation of the committee to present a paper on empyema in children, it has seemed worth while to take up certain aspects of the disease, *viz.*, its apparent obscurity and the frequent failure to detect its presence. The paper, therefore, will deal chiefly with the diagnosis of empyema and seek to discuss some of the difficulties met in its detection. It is based on observations and clinical studies made of both children (including infants) and adults,—on infants and children at two large children's hospitals over a long period of years; on adults at two base hospitals covering a comparatively short intensive period of ten months. In each of these hospitals an epidemic of pneumonia and empyema occurred during my term of service: at Camp Stewart, Virginia, in the spring of 1918; at Camp Devens, Massachusetts, in the fall of 1918. Thus there has been excellent opportunity for a pediatrician to make a comparative study of empyema as it manifests itself at different periods of life, and perhaps to give him a clearer insight into the difficulties encountered in the detection of disease. These difficulties appear to be due to the infrequency of empyema, its insidious and gradual onset, the obscurity of its physical signs, and erroneous interpretation of the physical signs detected.

The condition is relatively infrequent in children: it developed in 5% of 824 cases of lobar pneumonia and in 1½% of 557 cases of bronchopneumonia, treated in the wards of the Children's Memorial Hospital during the last ten