

## Original Articles.

A CLINICAL STUDY OF ONE HUNDRED AND THIRTY-FIVE CASES OF EMPYEMA, BASED UPON THE BACTERIOLOGICAL FINDINGS IN THE EXUDATE.<sup>1</sup>

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THE present paper is based upon the study of 135 cases of empyema treated at the Boston City Hospital during the last six years, and from the time that Dr. W. T. Councilman had charge of the pathological laboratory.<sup>2</sup> The cultures were made from specimens withdrawn by needle after careful sterilization of the chest, the drop of pus usually being coughed out through the needle into a sterile tube. In most cases the organism was determined from the result of a culture. In a very few cases it was determined morphologically, the growth being unsatisfactory. This was generally ascribed to the fact that the organisms were dying out of the exudate.

## ORGANISM PRESENT.

	Cases	Deaths
Diplococcus lanceolatus, Fränkel alone . . . . .	28	8
" " with others (unspecified) . . . . .	1	
" " with colon and pyocyaneus . . . . .	1	1
" " with Friedländer . . . . .	1	
" " with staphylococcus albus . . . . .	2	
" " with staphylococcus aureus . . . . .	2	
" " with staphylococcus citreus . . . . .	1	
Streptococcus, alone . . . . .	35	9
" " with lanceolatus . . . . .	18	2
" " with variety of others (unspecified) . . . . .	9	7
" " with staphylococcus aureus . . . . .	2	2
" " with staphylococcus albus and aureus . . . . .	1	
" " with saprophytes . . . . .	1	
" " with colon bacillus . . . . .	2	
" " with lanceolatus, staphylococcus aureus and colon . . . . .	1	
" " with lanceolatus and colon . . . . .	2	1
" " with lanceolatus and staphylococcus albus . . . . .	2	
" " with lanceolatus and pyocyaneus . . . . .	1	
Staphylococcus aureus . . . . .	6	4
" " albus . . . . .	1	
" " albus and aureus . . . . .	2	2
" " albus, with others (unspecified) . . . . .	1	1
" " albus, with m. tetragenus . . . . .	1	1
Pyocyaneus . . . . .	2	
Friedländer . . . . .	2	
B. typhosis . . . . .	1	
Colon bacillus with others (unspecified) . . . . .	1	
Sterile . . . . .	9	2
In all, Diplococcus lanceolatus appears in . . . . .	60	
Streptococcus pyogenes appears in . . . . .	74	
Friedländer (twice in pure culture) . . . . .	3	
Pyocyaneus appears in . . . . .	4	
Twice pure . . . . .		
(One with lanceolatus and colon) . . . . .		
(One with lanceolatus and streptococcus) . . . . .		
Colon bacillus appears . . . . .	6 times	
(One with pyocyaneus and lanceolatus) . . . . .		
(Two with streptococci) . . . . .		
(One with streptococci, lanceolatus and staphylococcus aureus) . . . . .		
(Two with streptococcus and lanceolatus) . . . . .		
Staphylococcus aureus appears in all . . . . .	13 times	
With diplococcus lanceolatus . . . . .	2 times	
With streptococcus . . . . .	3 times	
With streptococcus, colon and lanceolatus . . . . .	Once	
With albus . . . . .	2 times	
Alone . . . . .	5 times	
Staphylococcus albus appears in all . . . . .	7 times	
With aureus . . . . .	2 times	
With aureus and streptococcus . . . . .	Once	
With lanceolatus and streptococcus . . . . .	2 times	
With tetragenus . . . . .	Once	
Alone . . . . .	Once	
Bacillus typhosis appears once in pure culture.		

<sup>1</sup> Portion of paper read before the Association of American Physicians, April 30, 1902.

<sup>2</sup> My acknowledgments are due to the pathological department, to my colleagues on the medical and surgical staff of the hospital for permission to refer to their cases, and to Dr. Howard B. Jackson, house physician, for assistance in the labor of collating cases from the records of the various services.

The 135 cases included ninety-three males and forty-two females. The right side was involved in fifty-four cases, the left in seventy-one. Ages of the patients were as follows: Under the age of ten, fifteen cases (of these, three died); from ten to twenty, fifteen cases; from twenty to thirty, forty-one cases; from thirty to forty, twenty-four cases. The oldest patient was sixty-five, the youngest five months.

*Etiology.*—As some of the patients entered after having been ill several days, it is not always possible to be sure of the condition precedent to the empyema, but from the evidence of the record, taken in connection with the physical signs, it appears that pneumonia preceded the empyema in the great majority of cases,—eighty certainly, and fifteen more probably, or in all from ninety-five to one hundred. From this it will appear at once that the diplococcus lanceolatus has no distinct relation with the antecedent pneumonia, other organisms, especially the streptococcus, being as fully represented among these metapneumonic cases as are the diplococcus lanceolatus itself. The pneumonia was apparently also nearly always lobar. The period after the onset of pneumonia, when pus was first detected in ninety-six of the cases, averaged twenty-five days, the range being from six to sixty-six days. There were cases in which pus appeared after the onset of pneumonia, at six, seven, eight, nine and ten days. The longer periods may have been accounted for by failure to detect pus as early as it was formed. Some of the pneumonias were secondary to septic disease elsewhere, as, for example, cellulitis and abscess.

Tuberculosis was present in about twenty cases, and in a few of these acute pneumonia had supervened. Other causes of the empyema were typhoid fever, three cases; puerperal infection, two cases; appendicitis in one case (eighteen days previous to the empyema); actinomycosis, tonsillitis and otitis. Operations were performed upon 115 of these patients, leaving twenty cases unoperated upon. Of the latter, ten died, all of them being adults. Five of these were cases of diplococcus lanceolatus, two of streptococcus and lanceolatus combined, and one of streptococcus and aureus combined. Of the ten unoperated cases who recovered, eight cases followed pneumonia, one phthisis, one phthisis with pneumonia, three showed lanceolatus, three streptococcus, one pyocyaneus, one streptococcus and lanceolatus combined, one Friedländer, one lanceolatus and staphylococcus citreus combined.

Some of these cases were unsuitable for operation, for they seemed to be recovering, and the fluid withdrawn, while it contained pathogenic organisms, was not markedly purulent. Others were advised to submit to operation, but refused.

It will be noticed that in these two groups of the unoperated cases the lanceolatus was more prominent in the fatal half of the cases, but here, as will be also observed in the discussion of the mortality of the whole series, it does not appear that any great stress is to be laid upon the partic-

ular organism. While those present in the cases of pneumonic origin are quite as likely to be streptococcus as pneumococcus, it is to be noticed that cases connected with suppuration or sepsis elsewhere than in the chest showed a marked tenderness to the distinctly marked pus organisms. For example, of nine such cases, three were streptococcus, one streptococcus with an admixture, three aureus, and two aureus and albus.

*Details of operation on 110 patients.*—The site of incision was in three cases the anterior axillary line, in seventeen the mid-axillary line, and in forty-seven the posterior axillary line. In one case it was behind the scapula. Seventeen of the operations consisted of incisions through the pleura, without the resection of any of the ribs. Three times the fifth rib was resected, twice the sixth rib, thirty-three times the seventh rib, twenty times the eighth rib, five times the ninth rib, twelve times unspecified ribs, three times more than one rib was excised. The pleural cavity is recorded to have been irrigated one or more times in forty-six cases, and it is specially recorded that no irrigation was practised in thirty-four. The immediate effect of the operation was generally to reduce the temperature to a considerable degree, but this reduction was not always permanent. Sometimes the operation was followed by a marked rise of temperature, and this was generally of bad prognostic significance, although sometimes a rise of three degrees immediately after operation gave way to a subsequent favorable temperature curve and improvement in the patient's condition.

The agent most commonly employed was salt solution (nine times); next comes boric acid (eight times); permanganate of potash, peroxide of hydrogen, and sterilized water were also used. No special difference in the results of the various fluids was noticed, neither was there any marked difference in the outcome of the cases which were irrigated and those which were not. The cases were retained in the hospital after operation, as a rule, until the drainage was able to be discontinued and the treatment continued in the out-patient department.

Average time required for this in 76 cases, that is, the length of hospital residence after the operation in non-fatal cases, was about thirty-two days. Of the 135 patients, 92 left the hospital improved. A majority were well on the way to convalescence, a small amount of pus discharging from the opening, and the breathing heard down to the level of the opening. The subsequent history cannot be traced. In a few only the imperfect expansion of the lung gave reason to fear that the cure would not be perfect. In a number of instances the Wolfe bottles, in which the patient displaces a quantity of water from one bottle to another by blowing through a tube, were employed for the purpose of lung expansion.

In one patient there was a double operation (Case XXX). Boy, age ten, developed pneumonia of the left lower lobe Oct. 5, 1897, of the right

lower lobe Oct. 18. White count Oct. 12, 21,500; Oct. 30, 40,000. Pus was found in the left pleura Nov. 8. Operation 33 days after the onset of pneumonia by Dr. Munro. A Cabot-grooved needle was introduced into the pleura at lower end of the scapula, and sound showed a cavity occupying one-half to one-quarter of the left chest. At the same time pleurotomy in the right side with the resection of the rib; cavity larger than on the left, no irrigation. Culture from each side showed lanceolatus. Both incisions had healed in twenty-four days.

*Mortality.*—Of the 135 patients 40 died in the hospital, or 29%. Of these, five were three years old or under. With this we may compare the

*Mortality according to organisms.*—Of the 35 patients having a pure culture of streptococcus, nine died, or 26%; eighteen having streptococcus and lanceolatus, two died, or 11%; nine with streptococcus plus other organisms, seven died, or 77%; two with streptococcus plus aureus, two died, or 100%; twenty-eight pure cultures of lanceolatus, eight died, or 28%; two with streptococcus lanceolatus and colon, one died, or 50%; six cases of staphylococcus aureus, four died, or 66%; two cases of staphylococcus albus, one died, or 50%; two cases of staphylococcus aureus and albus, two died, or 100%; two cases of Friedländer, neither died, or 0%; nine sterile cases, two died, or 22%.

It will be seen from the foregoing figures that our experience does not bear out the statement made by Netter and others, referred to in the beginning of this paper, of the relative mildness of the lanceolatus cases and the gravity of the streptococcus cases, as the mortality from lanceolatus is slightly greater than that from streptococcus. The mixed infections on the whole appear more fatal than those of a single organism.

Of the five children under three years of age who died, three had streptococcus, two staphylococcus aureus.

So far, we have considered the mortality as represented only by cases dying in the hospital, but the subsequent history of the other cases cannot be traced. Many were very nearly well; some, though much relieved, were not "well," and a few probably went into a lingering decline.

After a pretty careful examination of the records I have selected five more cases which probably should be added to the list of fatalities, their condition being such that it is doubtful if they ever recovered. This would make a total mortality of forty-five, or 33%.

Streptococcus furnished of all deaths,	11-45, or 24%
" " of all cases,	37-135, or 27%
Lanceolatus furnished of all deaths,	8-45, or 18%
" " of all cases,	28-135, or 20%
Streptococcus with lanceolatus, of all deaths,	3-45, or 7%
" " of all cases,	19-135, or 14%
Streptococcus, with other admixtures, of all deaths,	8-45, or 18%
" " of all cases,	10-135, or 7%
Staphylococcus aureus, of all deaths,	4-45, or 9%
" " of all cases,	6-135, or 4%
Staphylococcus aureus, with admixtures, of all deaths,	4-45, or 9%
" " of all cases,	4-135, or 3%
Other admixtures, of all deaths,	6-45, or 11%
" " of all cases,	12-135, or 9%
Sterile exudates, of all deaths,	2-45, or 4%
" " of all cases,	9-135, or 7%

It may be interesting, taking these forty-five cases with their bacteriological contents, to compare the contribution made to the death list by each organism or combination of organisms with the proportion which they respectively represent of the grand total of cases.

(No importance is attached to this last, as some of the exudates probably owed their sterility to the organisms having died out.)

It will be seen that the first three of these groups, namely, streptococcus, lanceolatus and the combination, figure lower in the death list than in the whole number of cases, that is, they show a relative advantage in the matter of recovery, while the next four groups, namely, the streptococcus with mixed infections, and the aureus alone and admixed, show a relative disadvantage, that is, contribute more heavily to the death list than their numerical importance would warrant.

Hence, single organisms and the combination of streptococcus and lanceolatus are more favorable than the other mixed infections.

A more careful examination of the fatal cases shows that other conditions are of much greater significance than the variety of organism present. For example, suppurative processes in or outside of the chest were very frequent.

(a) In the chest there was abscess of the chest wall in one case; fetid pus or gangrene in the lung, three cases; pyopneumothorax, three cases, one of which died from hemorrhage of the wound and one from hemorrhage of the lung; actinomycosis, one case.

(b) Outside the chest: Septic inflammation of hands and feet in five cases, one of which had also carbuncle of the hip; parotid abscess, one case; suppurative otitis, one case; general peritonitis and abscess below the diaphragm, one case; purpura hemorrhagica, two cases; multiple injuries, one case.

(c) Other diseases: Sarcoma of the lung, one case; croup (no K. L. found), one case; aortic insufficiency, one case; mitral insufficiency, one case; chronic diffuse nephritis, one case; typhoid fever, two cases. The bacillus typhosus was especially looked for in the exudate, but none was found.

Ten of these patients died unoperated upon. In one, operation failed to reach pus, and in another the first operation failed to reach pus, and the second one succeeded, as the patient was moribund.

Of the thirty fatal cases which had a free opening of the chest wall, seven died on the table or within a few hours. Eliminating the case of sarcoma of the lung, which survived the thoracotomy for three months, the average duration of life after the operation in the other fatal cases was about nine days. In several patients the immediate cause of death was undoubtedly pneumonia, a definite extension of the consolidation being observed after the operation, sometimes to the opposite lung. In some of the cases post-mortem examination confirmed this extension of the pneumonic process.

Of the fatal cases the following are especially deserving of mention.

CASE XVI. *Actinomycosis*.—Female, age forty-eight. Swelling on and under the left breast. Considerable foul pus in pleura, sterile. Operation by incision and removal of the large actinomycotic masses found at the operation. Patient improved for ten days. Died seventeen days after the operation. Autopsy showed the right lung normal, left lung compressed, completely solid, intimately adherent to the pleura and chest wall so that masses had to be torn away. On the pleura surface was a dense fibrous tissue mass  $\frac{1}{2}$  cm. in thickness. Sinuses from the pleura to the left mammary region.

CASE XXII. *Sudden death without operation*.—Female, age thirty-eight. Four weeks after lobar pneumonia, first aspiration withdraws seven ounces of green pus left chest; lanceolatus. Temperature reduced 2°. Second aspiration a few days later was followed the next day by the sudden death of the patient; cause unknown. No autopsy.

CASE XX. *Typhoid Fever*.—Male, age thirty-seven. Typhoid fever. Widal positive, etc. Twenty-fourth day, chill; twenty-fifth day, phlebitis of left leg; forty-fifth day, pus by aspiration; a few days later, permanent opening; streptococcus pus. Ten days after this pus broke into the bronchus; bloody-purulent expectoration. Temperature rose to 103°. Death eighteen days after operation; sixty-five days after the onset of typhoid.

CASE CVII. Widal positive. Lobar pneumonia on the eighth day of typhoid with chill; twenty-nine days after pneumonia, 300 cc. bloody sero-pus aspirated, left chest; streptococcus pyogenes and staphylococcus aureus. No incision of chest wall. Patient died the day after the aspiration.

Compare with these the third case of typhoid (Case LXIV) not fatal.

Male, age thirty-four. Twenty-eight days after the onset bloody pus; aspirated left chest. Bacillus typhosus. Operation 22 days later; rib resected. Drainage for 60 days. Patient discharged nearly well 75 days after operation, 125 days after the beginning of typhoid.

CASE XXXIV. *Pyopneumothorax; abscess of the liver*.—Male, age thirty-six. Right renal calculus two years previous. Taken sick Jan. 2; ten days later one pint of pus aspirated, right chest; streptococcus and diplococcus lanceolatus. Ten days later signs of pneumothorax; eighth rib resected. Finger showed communication of empyema through the diaphragm into the abscess cavity of the liver. Patient died in three hours.

CASE XXXVIII. *Gangrene of the lung*.—Male, age fifty-six. Grippe about Christmas with pneumonia (?). After recovery worked two weeks and had to give up. Fifty-eight days after grippe, pus drawn from right chest; two days later patient died. Autopsy showed healed tuberculosis of the left lung; consolidation of right upper lobe; gangrenous area, 3 cm. in diameter, communicating with bronchi; also, independently, an abscess of the lung communicating with pleura. Contents of pleura very fetid, containing great variety of organisms.

CASE LXIII. *Purpura hemorrhagica*.—Female, age thirteen months. Entered July 11. Three weeks before, left ankle was swollen without redness. Pain on motion; swelling rapidly extended up the leg; leg constantly cold. This morning swelling of right hand. July 15: Punctate hemorrhages over trunk and neck. July 19: Left hand swollen, right foot bluish. Few hemorrhagic spots over right costal margin; marked edema of skin over left side. Upper left front of chest flat extending down into axilla; signs of fluid. Gradual extension of hemorrhagic spots over body. July 26: Chest bulging; aspirated nine ounces of green pus. Staphylococcus pyogenes aureus. Spots increasing over the whole body. July 27: Head retracted. No operation on chest wall attempted.

Aug. 1: Bleeding from the gums; more bleeding into the skin. Aug. 3: External strabismus. Died apparently from intracranial hemorrhage.

CASE LXXI. Female, age thirty-nine. Phthisis; exudate thin, odorless pus. Staphylococcus aureus and albus. Day after the operation purpuric spots over the body. Died second day after the operation.

CASE CI. *Sarcoma of the lung*.—Female, age fifteen. Leg had been amputated at the hip for sarcoma some time previously. Pneumonia on the twenty-third day; pus in the pleura. Immediate operation; resection of the fifth rib in the right anterior axillary line. Right chest gradually grew larger. Repeated aspirations failed to detect any more fluid. The patient gradually failed and died ninety-seven days after the operation. No autopsy.

CASE CXIII. *Pulmonary thrombus*.—Female, age eleven. Patient had septic hand on March 1; septic foot on March 14; cough, pain and fever, March 14. March 21 operation upon hand and foot. Irregular temperature.

April 4: Operation on right pleura. Fifth rib, outside nipple excised; much cloudy serum containing staphylococcus aureus. Same organism had already been present in the pus removed from the hand and foot; spleen and liver enlarged, the latter reaching nearly to the umbilicus. April 30: There being evidence of retained pus, a trochar was inserted in the eighth interspace, anterior axillary line. It penetrated the liver; no pus. Trochar inserted again in the back into the pleura, withdrawing a little serum. Then the old tract was explored and a little retained pus extracted. White corpuscles, 17,000.

May 8: Tenderness over the right calf and femoral vein. May 9: Died suddenly, thirty-six days after the first empyema operation, and forty-nine days after the onset of empyema. Cause of death believed to be pulmonary thrombosis. No autopsy.

*Perforation into bronchi*.—The general unfavorable significance of this occurrence is confirmed by our experiences. Such a perforation took place in twelve cases. Of these seven died in the hospital and two were discharged not much relieved. In five of these there were streptococci with other organisms; in one case the combination being with saprophytes, in one staphylococcus albus, in two lanceolatus, and in one lanceolatus pyocyaneus and colon. The three remaining cases of the twelve which were probably recoveries, had streptococcus, Friedländer, and an exudate which was sterile.

CASE IX. *Pulsating empyema*.—Female, age nineteen. Entered Dec. 30. Four days after acute attack pain left chest, though cough had been present for a few weeks. Aspirated Jan. 2, 24 oz. clear serum. Temperature continued high with oscillations of 4°; patient refused to be aspirated till Feb. 16, when there was a dry tap though needle felt free in pleural cavity.

March 2: A slight bulging was noted at third space in front. Also two similar spots found in seventh and eighth spaces in axilla, all pulsating synchronously with heart beats. At one of the lower spots, needle introduced and 30 oz. pus removed (streptococcus). This stopped bulging and pulsation. Further operation refused, but accepted later, and on March 10 seventh rib excised. After this, temperature came down to 99-100°, with slight oscillations, except for two or three days, when there was a diurnal range of 21°.

Discharged thirty-nine days after operation, with sinus nearly healed; no pulsation, but breathing only heard to third rib.

CASE CXXX. *Gangrene*.—Male, age forty-two. Lobar pneumonia followed by profuse, fetid expectoration. Leucocytes at beginning of empyema, 11,000; 7,200, when pus found in the chest. At the time of operation a gangrenous mass of large extent found in

the lung and scooped out. Temperature came down and so continued except on the forty-fifth day, when the patient had a fever lasting four or five days, with signs of consolidation in right upper lobe. Examination of the chest fifty-three days after the operation shows good breathing in the right chest in front to the base on the mammary line. In the axilla the breathing is absent below the level of the nipple. Behind breathing is good to mid-scapula, but below this is scanty. Air is expelled through the opening by cough.

CASE XCVII. *Penetration of pus below diaphragm*.—Female, age twenty. Tubercular pleurisy two months. Tubercular focus left apex. Patient cannot raise the left arm. Foul pus aspirated. Operation. Discharge remained excessive. Streptococcus, lanceolatus and colon-like bacillus. Patient died twenty-five days after operation. Autopsy showed empyema, localized peritonitis, subphrenic abscess, perisplenitis.

CASE CXXXV. *Purulent otitis media*.—Male, age one year. Subacute otitis media; twenty-three days afterwards thick pus in pleura. Staphylococcus pyogenes aureus. Twenty-five days after the aspiration, operation with resection of the eighth rib. On the second day temperature rose to 104°, where it continued until death on the seventh day. On the sixth day, there being evidence of retained pus, ten to twelve punctures were made over the flat area in the back. No pus obtained. The last puncture entered the stomach. Autopsy showed 100 cc. of very turbid puriform fluid in the pelvis. Considerable recently formed fibrinous exudate about liver, spleen and hollows of the greater or lesser peritoneal cavity. Left pleura uniformly thickened 1 to 3 mm. Posterior half of the left pleural cavity entirely obliterated by chronic dense fibrous bands. Complete atelectasis.

*Leucocytosis*.—Cases of pneumonic origin had the leucocytes belonging to that condition, and the change in the white count due to the super-vention of empyema was not marked nor constant. In some cases there was a fall in the white count, and in some a rise; for example, Case LXXXIII had lobar pneumonia April 27. On May 4 the white count was 25,600. On May 16 pus was discovered, streptococcus and pneumococcus, and the white count on that day was 14,800.

On the other hand Case LXXXII had lobar pneumonia April 16. White count, May 5, 23,200; May 15, 31,400; May 16, streptococcus pus aspirated. Operation refused. Patient discharged seven days later, temperature of the last four days having been nearly normal.

CASE XI. *Chronic sinus with retained foreign body*.—Male, age eighteen. Was operated upon for empyema May 19, 1896. Rib not resected. Discharged relieved thirty-two days later to Out-Patient Department. Second operation, April 16, 1897. Sixth rib resected, followed by a rise of temperature and irrigation. Discharged in twenty days, relieved, to the Out-Patient Department. Third operation two years later. Exostosis eighth and ninth ribs, which were both resected. A rubber drainage tube was found in the pleura which had been lost after one of the previous operations. Cavity cured. Discharged relieved.

CASE XV. *Discharged gastric contents*.—Male, age seven. Green foul pus five weeks after lobar pneumonia. Bacillus coli communis and others. Resection of the seventh rib midaxillary line. Records state that for about ten days the wound discharged fluid apparently containing gastric contents. Patient leaves hospital thirty days after the operation. Moderate purulent discharge. General condition improving.

*Consecutive aspirations with development of pus*.—Our experience coincides with that of other

observers in having noted several instances in which an exudate, originally clear serous, has gradually become purulent. For example, Case XLV, thirteen days after lobar pneumonia, had clear serum in the pleural cavity, containing, however, streptococcus. One week later fluid still contained streptococcus and also pus.

CASE CXIX. Twenty-nine days after lobar pneumonia had one ounce of straw-colored fluid containing pneumococcus. Eight days later fluid seropurulent; culture, pneumococcus. Thirteen days later patient moribund. Fluid purulent. Here the leucocytes diminished from 38,000 on the fourth day of pneumonia, to 21,000 during empyema.

CASE CXXV. Lobar pneumonia March 29. Aspirations April 16 and 29 and May 20. The latter one was diplococcus lanceolatus. Patient declined operation and left the hospital nearly well.

In some cases the consecutive aspirations indicated a change in the organisms present, for example, Case CXI was tapped repeatedly, following a lobar pneumonia, and sterile serous fluid was obtained. Finally, seven weeks after pneumonia, the exudate contained staphylococcus pyogenus aureus.

Again, Case LXXVII had lobar pneumonia Feb. 1. Aspirated March 2, clear sterile fluid. Again March 7 the same. On March 14 clear fluid but blood stained. Staphylococcus aureus and albus. Next day pus from both ears. Again March 25 brown pus in the pleura. Immediate operation. Temperature very septic. Patient died on the seventeenth day.

*Subdiaphragmatic abscess with secondary purulent pleurisy.*—The two following cases are not included in the 135 cases previously discussed because the infection started from below the diaphragm, but they may be mentioned here as having points of interest in this connection.

The first was a collection of pus below the diaphragm, and an aspirator needle was introduced in the ninth space in the left anterior axillary line. It was subsequently found to have penetrated the stomach, which shows that care must be taken in aspirating at a point so low down and so far forward. The autopsy showed pus below the diaphragm with secondary abscess of the lung.

The second case was that of an Italian, age thirty-five, who, in November, 1898, had an attack of diarrhea lasting for one month, followed by pain for a week, then a return of the diarrhea. April 3, 1899, bulging of the ribs on the right and tenderness with dullness below the level of the nipple. One inch of the ninth rib excised in the midaxillary line. Several quarts of thick pus evacuated. Abscess seen to be subphrenic. Patient died on thirteenth day. Autopsy showed healing diphtheritic ulcers of colon, abscess of liver and empyema. The operation wound entered the abscess between liver and diaphragm; the upper end of the operation wound entered pleural cavity, so that tip of finger can pass from peritoneal to pleural cavity. The pleural exudate was supposed to be caused by infection through this opening. Unexpanded lungs.

In varying patients a great difference is noted at time of operation in the matter of expansion of lung, and this difference is not always easily accounted for. Sometimes the lung expands immediately and then contracts again. Sometimes it does not expand at all. It is generally sup-

posed that non-expansion is more likely where the pressure upon the lung has been long continued, but this is not always true.

In Case CXXXII, a healthy young man of twenty-one, with lobar pneumonia, pus (streptococcus) was detected exceptionally early, namely, on the fourteenth day, and an operation was done on the fifteenth day, with a resection of the seventh rib. An examination of the patient on the fifty-fourth day after the operation showed a marked shrinkage of the chest wall but a great interval still between the outside of the lung and the inside of the pleural cavity, that is, no expansion had occurred.

It seems reasonable to suppose that the early operation, in this case before the pneumonic process had given way to resolution, may have hindered lung expansion.

The conclusions which I draw from the study of these cases are the following:

Empyema, while capable of being caused by manifold infections within and without the chest, is in the majority of cases the result of pneumonia. The character of the pneumonia is not to be judged by the organism present in the empyema. For as it has been shown by Weichselbaum that even in lobar pneumonia other organisms, notably the streptococcus, may be present in the lung as an admixture of the one which we consider the septic cause of lobar pneumonia, namely, the lanceolatus of Fränkel, so there is an opportunity for that contaminating organism to penetrate to the pleura. The lanceolatus, if present, may probably be taken to indicate a previous pneumonia, but the streptococcus if present may equally indicate a lobar, lobular or grippal pneumonia, or a phthisis with mixed infection. As a tuberculosis acquires greater malignancy after it acquires a mixed infection, so it may be that these lobar pneumonias in which a streptococcal contamination is most marked, are the ones most liable to produce an empyema, and that the organism in the purulent exudate is as likely to be the contaminating as the original infection.

When the streptococcus is due to suppurative or pyemic conditions outside the chest, it is probably of a more virulent type and has a correspondingly bad prognosis. But in the metapneumonic cases the prognosis of streptococcus seems to be but little worse than that of lanceolatus.

The great difficulty in securing the healing of operated cases is in bringing the opposite pleural surfaces into permanent contact. When the lung does not fully expand (as is usually the case) the thoracic wall must go in to meet it. This is one reason for the free resection of ribs, and the relatively favorable prognosis in childhood is due in part to the greater liability of a soft and flexible chest wall to contract upon the lung.

Some cases certainly recover without operation. It is difficult to determine in advance which these will be. The particular organism present is a less cogent factor in determining the need of operation than the fever, prostration, chills, the

quantity of pus cells present and the tendency to refill after aspiration.

The gradual development of pus after successive aspirations can usually be predicted from the presence of strepto- or pneumococci in the first fluid withdrawn, even though that be a clear serum. But pus may appear when the earlier tapplings are sterile — perhaps from a later infection from within the lung.

A needle introduced into the same intercostal space in two patients may in the one case enter the pleural cavity and in the other the stomach, according as the diaphragm is arched up by fluid below it or pressed down by fluid above it. Hence the importance of diagnosing empyema from subphrenic abscess.

Perforation of an empyema into a bronchus from undue delay in operation is a dangerous condition. But the opening of the thorax while an underlying pneumonic consolidation is still unresolved is not conducive to ready expansion of the lung, and a moderate delay of the thoracotomy till the pneumonia has resolved, meantime keeping down undue compression by an occasional aspiration of the pus, is a conservative procedure.

#### ROUND SHOULDERS AND FAULTY ATTITUDE: A METHOD OF OBSERVATION AND RECORD, WITH CONCLUSIONS AS TO TREATMENT.\*

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THE present paper is intended to call attention to a simple and fairly accurate method of observing and recording faulty attitude in standing. This matter is of importance because the type of faulty attitude known as round shoulders, for instance, is not a local, but a general disturbance of the anteroposterior balance, involving pelvis, legs, and feet as well as the spine. Former observations have been concerned mostly with the spinal curve alone, but to appreciate the affection properly the base of support must also be considered. This method of record throws a certain practical light upon the question of treatment.

*Method of measurement.*—Measurements are taken from a perpendicular plane behind the body, the distance of certain easily recognized bony landmarks being taken. The measurement aims to give a side elevation of certain points in the skeleton.

The method has been in use two years, and the material at my command consists of seventy-two observations made on normal boys between the ages of fifteen and nineteen years, by Dr. A. M. Greenwood, to whom I am indebted for much assistance in all my observations; of some six hundred observations on young women, made by the physical director of one of the women's colleges; of a hundred or more observations made by the writer and some assistants in the scoliosis clinic

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of the second surgical service of the Children's Hospital; and on a series of about the same number made on cases of faulty attitude in private practice. Cases of marked scoliosis have not been taken into account in the following analysis, as they seemed to form a separate problem of much importance, to be taken up after more information was obtained about the normal attitude and the common anteroposterior variations.

The apparatus by which the measurements are taken consists of the ordinary wooden upright

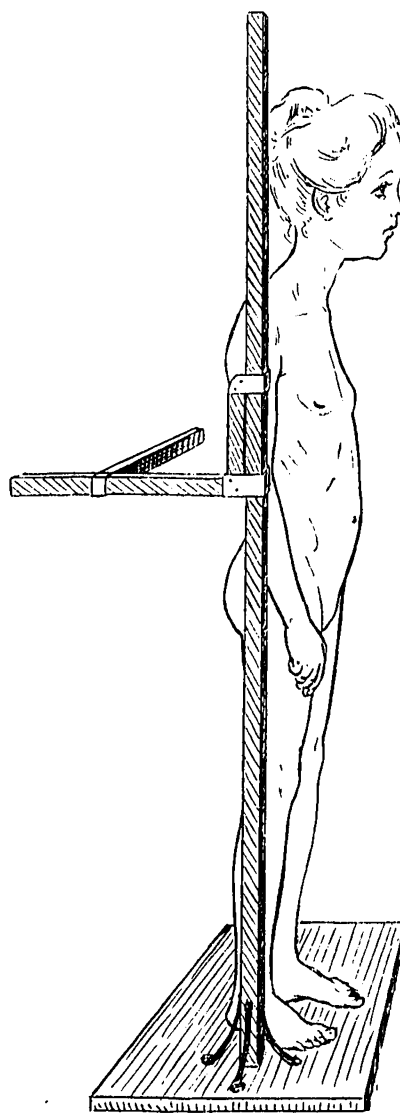


FIG. 1.—Apparatus for measuring variations in attitude.

with a sliding arm used for measuring the height. On this sliding arm and at right-angles to it is a horizontal arm eighteen inches long, which is placed at six inches from the back surface of the upright rod. This back surface of the upright rod is taken as the perpendicular plane from which distances are to be noted, and the measurements are made from the sliding horizontal arm, which is always six inches distant from the back surface of the upright (Fig. 1). Any point,