PLEURAL EMPIEYMA.

ACUTE AND SUBACUTE

With special reference to the Bacteriology of Pleural Effusion and the serious complications occurring during the Progress and Treatment.

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INTRODUCTION

The subject of Empyema has gained greatly in scientific and clinical interest by the changes in its pathology resulting from bacteriological research. This may be said to be the development of the last decade, approximately, in the progress of Medical Science, for we find that Bouveault (1888) in his classical work makes but little reference to the organiial sources of pyothorax. And it is more particularly from a diagnostic point of view that our knowledge has been improved, while we now recognize that it is by a more exhaustive criticism of the history, pathology and present condition of the case at hand, for each individual case, the lines of treatment, of which, nevertheless, the most modern methods are to be regarded as in great measure revivals or modifications of those formerly employed for all purulent thoracic effusions, even from the days of Hippocrates. In this country it has not been customary to differentiate much between serous and purulent effusions; no important monographs have been written on Pleural Empyema "per se", and the more important papers on this subject have to be
Sought for in the pages of our Journals and general text-books, or in the hand-foreign literature, especially French, has given us the exhaustive and standard works of Rettger, Bouveret, Delive, Courvi-Suffit and Cestan. But it is also noteworthy that recent researches would indicate that the clinical pathological distinction between the two varieties of pleuritic effusion are by no means certain. Are we to regard all pleurises as organical in origin and toxic in quality?

If so, what are the conditions that determine when inflammation of the Pleura will lead to purulent or to serous effusion? The most recent theories would suggest that all acute sero-sero-fibrinous pleurises are due to the Tuberculosis Bacillus, that Empyema is of septic origin alone, and that the tubercular variety of Pneumonia is to be regarded as a mixed form or rather that pyogenic infection has been superadded to tubercular at a later date in the clinical history of the case. Mixed infection, except in the true Pneumococcal Empyema, is most frequently met with, hence a definite classification of the types is rendered difficult; still less can we classify the cases from a clinical standpoint; each particular case

...
must demand the choice of treatment best suited for that type to which it conforms. Therefore the importance of early diagnosis, of bacteriological examination of the fluid, and of prompt treatment by the various methods which now often in this, as in all progressive sciences, far greater chance of success. The diminished death rate in cases of Pleurisy & Pneumonia is the best testimony to the advances made in this direction, and the extensive operations demanded in chronic cases are, without doubt, becoming less frequently necessary.

The formation of pus within the pleural cavity, from whatever cause, implies a process of inflammation sufficiently acute to lead to the rapid breaking down of leukocytes and connective-tissue cells; this would imply that sero-fibrinous is less acute than purulent Pleurisy, while on the other hand we cannot regard this as a clinical axiom. Any inflammatory process must have an organic cause, and possibly it is because of the difficulty of finding particular micro-organisms in the sero-fibrinous effusion that we have hitherto been accustomed to make distinction between this form and that in which pus makes its appearance from the beginning. In any case, we must now
discard the terms "simple" or "disseptic" as applied formerly to the milder forms of Pleurisy with effusion. An Empyema, as a general rule, is such through-out its course; the fluid at first may be thin and watery but is always somewhat turbid; when a simple serous effusion becomes septic it would indicate that a secondary infection has taken place, and that the Pleura is undergoing a second or more virulent form of inflammation leading to a greater destruction of tissue elements. As will be observed later, this process is most characteristically seen in the Tubercular type of Empyema where the repeated attacks of inflammation and the secondary infection of the Pleura lead to the most intractable form of Pythiosis. In the greater majority of cases true pus is found in the pleural sac at the earliest stage of effusion, the rapidity of its formation depending, in great measure, on the etiology and the general physical condition of the system. This latter one finds to have almost invariably suffered previously from some illness, acute or chronic, to which the cause can be traced, or which has predisposed the patient to the attack of the bacteria which are more directly causal. We must, for practical purposes, regard Empyema as a secondary
Conditions; the primary disease may be slight and even unobserved by patient or physician, or so severe on the other hand, as to mask the secondary disease whose existence is only noticed when convalescence from the primary sets in.

The various types of Pleural Effusions can be grouped into series according to whether the cause is intra- or extra-thoracic; from the point of view of etiology, primitive or secondary; from their clinical or anatomical aspects; or, as has most frequently been adopted, by the bacteriology of the effusion and the pathological processes which each case exhibits. It would seem best to discuss the latter at greater length; the symptoms and diagnosis, which, on the whole, conform to a more or less general type, do not demand so much attention here; the complications, especially those associated with the progress and treatment of Pleural Effusions are of special interest; and the numerous methods of treatment best suited for the individual or type of case must be dealt with in more detail.

I shall not extend this thesis beyond the subject of Acute and Subacute Effusions, and in doing so shall endeavour to review most of the writings...
and researches of authorities of recent date, and
sum up the general results of their conclusions;
I shall describe in detail a series of illustrative
cases that have come under my own experience,
supplementing these with others quoted by authorities
and writers on the subject.
Enyema in children has, in many respects, a
greater importance than in adults; but while
such cases are more complex in diagnosis and
treatment, on the whole better results have
been obtained in the former than in the latter,
if we can rely on the statistics furnished from
many sources. I shall endeavour to indicate the
differences, while at the same time point out
that no important distinctions can be made
dexcept as regards the recuperative powers
of youth and their bearing on prognosis.

As regards Bibliography and References, I append (p.144)
a list of the Books and Articles on the Subject to which
I have been most indebted. To furnish a complete
list of all the numerous monographs and papers consulted
or referred to would be too extensive, but most references
required will be found indicated in the text.
ÆTIOLOGY

Sex — is not of marked importance as regards the incidence of Purulent Pleurisy; in childhood, we find that females are as frequently attacked as males, but among adult cases there is a marked preponderance of liability in the latter, probably arising from the greater exposure to more trying conditions of life which men have to undergo.

Age — Empyema is more common in children than in adults, especially as a complication of Pneumonia, in the former owing to the greater intensity of the inflammatory process and the weaker resistance powers of the tissues, pus is more readily produced of the various acute febrile disorders which are liable to attack serous membranes are most frequently met with in children. The condition is most frequent in children below the age of 6 years and in adults between 20 and 30 years of age, but may of course occur at any age. A senile type, rarely purulent, has been specially studied by Lemoiné (Journal de médecine, July 1898).

Constitution and Previous Health — have considerable influence on the occurrence of Empyema; the Tubercular diathesis shows a special liability to Pleurisy.
both serofibrinous purulent, as also in individuals weakened by Alcoholism, Cancer, Pneumonia and Hepatic disease.

Chill—has long been accepted as a frequent cause, either because the susceptibility to the attack of bacteria is increased by any sudden lowering of the body temperature or because the initial report that ushered in the disease in many cases is misunderstood by the patient. Lindsay (Encyclopaedia Brit. Vol IX pg. 352) obtained the history of a chill in 26 out of 74 cases of acute pleurisy, but considers that, while the influence of chill cannot be eliminated, too much must not be allowed to the statements of patients as to the actual occurrence of such.

The direct or immediate cause of Effusion in the attack of Microorganisms on the Pleural Membrane visceral + pleural and its underlying connective tissue; but, while the disease may commence as a primary one in the Pleura, indirectly the sources of infection naturally group themselves as "intra thoracic" and "extrathoracic", the former being the more common origin of the disease. Here we may remark that the Pleural Membrane is apparently much less resistant to the attack of septic infection.
reaching it from without, i.e. through underlying tissue, than the Peritoneum, a fact which I think is not adequately accounted for by the theory of 'tolerance' in the latter (vide Bayard Holmes quoted by Peter, Surgery of Chest)

1. Intrathoracic causes

Acute Lobar Pneumonia is the principal source of the majority (60%) of cases in children, and a smaller proportion (25%) in adults; along with this may be placed Bronchopneumonia which doubtless accounts for many of the cases formerly attributed to such exanthemata as Whooping Cough and Measles. In children bacteriological and clinical evidence all indicates that a previous or simultaneous inflammation of the lung tissue precedes the extension of the microorganisms to the pleural cavity; thus Simmonds (Brit. Archiv fur Klein med., Band XXXIV) found 31 cases out of 40 due to Pneumonia, Petten (Soc. Rett. des Kriegers 1899 +1890) 14 out of 27, Hothiüger (Vier. de Zurch 1892) 36 out of 43, Höffricht (Cepos de Vienna 1893) 21 out of 28, Holt (Archives of Pediatrics 1892) 19 out of 20, Astaur (Archiv. fur Kinderheilk. Band XIV, 1893) 22 out of 32. Fiedelerstein (Vier. de Paris 1890) from Collected Series found 97 out of 258 cases or 35%, but as there were few records previous to 1890 we must regard it as being an under-estimation. Sutterlin (Berat. June 1895) in 21 cases
of double empyema found 15 due to Pneumonia. From a series of 53 cases in the Royal Hospital for Sick Children in Edinburgh, I find that at least 37 gave a previous history of Pneumonia, usually of lobar type. In adults, on the other hand, Acute Pneumonia does not lead to as large a proportion of cases of Purulent Pleurisy, although by itself it has a much higher mortality than in children. Sero-fibrinous effusion accompanying or following Pneumonia in adults is of frequent occurrence, and it would appear that in children such effusion shows a greater tendency to be purulent. Förster (Archivum Med. Woeh. 1872, pgs. 745-822) found in adults only 12 out of 21 cases due to Pneumonia, Acute (Archivum Med. Woeh. 1872 pgs. 741-1817) 12 out of 33, Hofmeister (Congres de Venise 1874) 37 out of 60, Schade (Handbuch der Pneumol. et Statist 1877) 573 out of 709, and later Hale White finds only 41 out of 525 (vib. Mediz. Woeh. 1902).

We thus find that Pneumonia is the cause of Pyothorax in about 65% of cases in children and 25% in adults. Tubercular disease of the lungs may be regarded as the next most frequent cause, especially in adults; this is especially so when we find that modern research shows that the true sero-fibrinous type is in many cases of tubercular origin. Tuberculosis may exist in the lungs - hence spreads to the Pleura, or as is not
Infrequent a septic infecition may be superadded. Further on it will be shown that the great majority of cases of Acute Enphymosis which occur in Empyema with Pulmonary Tuberculosis are not tubercular, and it is mostly the slow or chronic types that are truly so. In children, Simmonds (cited) finds 12 tubercular out of 31 cases, 

Szurkis (Zeitschr. der kopenhag. 1892) 10 out of 59, 

Frinklestein 29 out of 255 or 10%; in adults Buller (cited) finds 15 out of 156 or 10% which may be regarded as the most reliable general estimation. Of other intrathoracic causes, one must particularly mention Bronchiectasis + Pulmonary Sycosis which usually lead to fibrin or acutely septic types of Empyema; less frequent are suppurrative processes in the Mediastinum + Bronchial Elands, Pericarditis + Endocarditis (the latter more truly closed under Pericardium), Ulceration of Trachea + Oesophagus, Caries + Necrosis of Ribs + Spinal Column, Peritonitis without abscess of chest wall + in rare cases Emphysema, cannot quite be classed as truly intrathoracic.

2. Extrathoracic Causes — The part played by the various acute infective fibrile disorders is important; many of these act thus in two ways, viz. firstly as causing direct primary inflammation of the pleura, and secondly as liable to be complicated by Pemphonia...
Serosupraventricular pleurisy, where the Empyema may arise. Thus measles, pertussis, is frequently followed by bronchopneumonia, typhoid fever and influenza by lobar pneumonia, Smallpox and scarlatina may occasionally act thus but more usually as direct causes of septicemia character. Anthrax, plague might also come under the same category. Septicemia and puerperal fever are undoubtedly the most important of extra-thoracic sources, more frequent in adults than in children; such effusions of脓 are incult cases found to be due to streptococci which reach the pleura indirecly through the lungs but also directly; under this head we would include osteomyelitis, arthritis, pelvic cellulitis, perimphritis, cerebro-mental abscess, venous thrombosis, pleurisy.

Sepsis through the enlargement of glands resulting from streptococcal infection usually associated with staphylococci. Tubercular glands, cervical, bronchial and abdominal.

Cellulitis and retropharyngeal abscess are rarer causes, occasionally reaching the pleura by direct extension.

Abdominal peritonitis, in rarer cases, may be source direct or indirect of infection of the pleura, thus, peritonitis especially tubercular form, typhoid abscess, subpharyngeal abscess, uterine perforation of Strudel infection of umbilical cord in the newly-born infant. etc.
So also more indirectly from Appendicitis, Suppurative Peritonitis, Cystitis, Pericarditis, &c. Such cases being probably pyemic or metastatic in character.

In conclusion, it is to be noted that, in view of recent researches on the bacteriology of Pleural Effusions both serofibrinous and purulent, the proportion of Empyemata of Tubercular origin must be increased, and the presence of other pathogenic bacteria than the Pneumococcus of Frankel (in the absence of the latter) in the effusion does not negative the existence of a recent Pneumonia. From careful examination of numerous reports and statistics of recent date, I would tabulate the causes of Empyema in the following proportions,

<table>
<thead>
<tr>
<th>CAUSE</th>
<th>IN CHILDREN</th>
<th>IN ADULTS</th>
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<tbody>
<tr>
<td>Pneumonia, Croupous &amp; Catarrhal</td>
<td>60%</td>
<td>35%</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>10%</td>
<td>25%</td>
</tr>
<tr>
<td>Specific Fevers</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>Other Intra-thoracic Causes</td>
<td>4%</td>
<td>10%</td>
</tr>
<tr>
<td>Extrathoracic Causes</td>
<td>6%</td>
<td>20%</td>
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Bacteriology.

The bacteriological classification of the different forms of pleural effusion, while at considerable variance with the actual clinical types, offers the best method of systematizing our knowledge, and the microorganisms discovered in any sample of fluid removed from the chest for diagnosis must have an important bearing on the prognosis and treatment of each case. It has been found that bacteria easily demonstrated in purulent effusions are also though with greater difficulty to be discovered in serous and serofibrinous effusions. The trend of general opinion of late years would indicate that all serous effusions in which no organism can be discovered are of tubercular origin; the presence of pneumococci and pyogenic bacteria in such has been clearly demonstrated. But the exact relationship of microorganisms to serous and purulent effusion is still hypothetical.

I. Bacteriology of Serofibrinous Pleurisy.

Inflammation per se is of bacterial origin in practically all cases, and however much we grant to the predisposing cause it is evident that microorganisms must have or still exist in however small a transmi-
amount in the inflamed tissues. So, in the case of
Pleurisy, it must not be presumed that, because
an exudate gives sterile results by all methods
of examination, it has an aseptic origin. That
the tubercle bacillus plays an important part in
the causation of acute caseous fibrinous Pleurisy is
an undoubted fact but how far we can hold
this as a general rule is not certain. The
difficulties of finding bacilli, which may be few
in number or have perished by their own toxins,
are numerous; unless the whole effusion can
be carefully examined, after "centrifugalising," by
microscope, culture, and inoculation, we are not
justified in excluding microorganisms. Moreover,
as has been pointed out by Thun, other factors
affect the causal organisms may remain
almost entirely within the substance of the serous
membrane and its subjacent areolar tissue, in
the fibrinous masses or granulation tissue which
thicken the membrane, in detached masses of
fibroin, and especially in parts of the lungs or
Pleural cavity not easily accessible. Again
the Pneumococcus, as will be referred to later,
is an organism of low vitality, and is often
perished, and on the other hand Streptococci often sho
Sufficient virulence for a comparatively small number to create an extensive and severe inflammatory reaction in the tissues. Jakowski (quoted by Lindsay's Encyclopaedia, etc., Vol. IX, page 387) sums up his conclusions on the whole subject of the bacteriology of pleurisy as follows:—

1. That all pleurisy is due to microorganisms, though these are not always to be found;
2. That where microorganisms are found the case is probably tubercular;
3. That primary genuine pleurisy, not due to tuberculosis, is most often due to the Pneumococcus; 4. That serous exudation in which pyogenic organisms are found have a greater tendency towards empyema; 5. That exudation during or after pneumonia are most often dependent on Frankel's Diplococcus.

Laudouzy (Revue de Médecine 1886) thinks from 70 to 75% of all serofibrinous pleurisy are of tubercular origin; later he has placed this proportion as high as 95-98%, but this seems rather excessive.

Termeau Séé's (les Maladies Simple du Pleurésie, Paris 1891) says: "so-called simple pleurisy from a chill is only a tuberculous pleurisy the nature of which has been misunderstood" and "the proportion of such cases is 75%.

Osler (Shattuck Lectures on Tuberculous Pleurisy 1893) reports that from post-mortem records he found only 32 cases to be of tuberculous origin out of 101 successive cases of
acute pleurisy. He also says (Principles & Pract. of Med. 1897) "the more carefully I have studied the question the clearer does the |proposition appear 2 be of primary pleurisy's of tuberculous origin; the subsequent history of cases of acute pleurisy forces us to conclude that in at least two-thirds of the cases it is a curable afflication."

Kelsch and Vaillant (Archiv de Physiol. 1895 — quoted by Strauss in la Tuberculosis et son Bacille, Paris 1895, page 105) found that of 113 cases of acute pleurisy, nearly 82% proved to be tubercular and the authors conclude that ordinary pleurisy is only the manifestation of local tuberculous. They examined 16 fatal cases of pleurisy, in all of which tubercular granulations were found on the pleura while the lungs were free from infiltration or presented a few recent lesions. By inoculation of animals tubercle was reproduced in 2 out of 4 cases of purulent effusion and 1 out of 10 cases of serous effusion.

Lemmens and Chaufrord (See Rev. des Hopitaux 1895, v. 1896) inoculated 20 guinea pigs with the effusion withdrawn from 20 cases of serofibrinous acute pleurisy, and, although in no cases were tubercle bacilli discovered in the withdrawn fluid, in 10 of the animals tuberculous developed.

Lemoinne (Bulletin des Hopitaux 1895, page 256) made cultures
from the effusion in 32 cases of acute serofibrinous pleurisy in robust individuals with no heredity to tuberculosis; the results were sterile in 28, and in 4 cases pure Staphylococcus Albus was found; but of these 28 cases only 5 could be classed as cured, for 1 case that pulmonary tuberculosis, 15 developed it later and 7 showed suspicious signs at the spine.

Mitchell Budden (New York Medical Journal 1893) found micro-organisms in only 2 out of 21 cases, and the Pneumococcus in 2 cases of Serous Effusion following Pneumonia.

Goldschieder (Zeitschrift f. Klin. Med. 1892, LXXI, 863) found Staphylococcus in 3 cases of Serous Effusion which did not become purulent and Staphylococcus in 1 case.

Passini (Centralblatt fur allgem. Path. 1893) examined 15 cases of Serous and 8 of Purulent Effusion, his results were:

+ Serous Effusion — Tubercle Bacillus in 6 cases
  Pneumococcus in 3 cases
  Staphylococcus in 1 case
  No microorganisms in 5 cases

+ Purulent Effusion — Tubercle Bacillus in 3 cases
  Staphylococcus & Staphylococcus in 3 cases
  Pneumococcus in 1 case
  No microorganisms in 1 case.
In one hemorrhagic effusion he found tubercle bacilli, as did also Naut (Rev. méd. des Hôp.: 1893, x, 732). Joffre (Bulletin des Hôpital: 1890, 549) in 80 cases of acute "idiopathic" pleurisy by inoculation got tuberculosi in 8 cases, but only 7 cases out of 12 which were clinically tuberculous. He puts the proportion of cases of serofibrinous pleurisy due to tuberculosi at 65%.

Aschaff (Zeitschrift für die Med. Rund XXXIX, 1890) found micro-organisms in only 7 out of 200 cases of serous effusion; in 2 cases following pneumonia he found streptococci once, pneumococci once, similar results also in 2 cases of so-called idiopathic pleurisy. By inoculation of the serous effusion from 57 cases of acute pleurisy, the results obtained were—

Of 19 cases secondary to pneumonia, Pneumococci vs. tuberculosi in 0.

12 " certainly tuberculous — " " 7.

12 " doubtfully tuberculous — " " 9.

12 " of idiopathic pleurisy — " " 9.

Lert (Archiv für exper. Path. u. Therapie 1890, 1895; also in Beleg neueste Med. Wochenschrift 1895) examined 54 cases, of which 37 were serous and 17 purulent effusions; in 6 cases secondary to typhoid, Staphylococci found in 3, hepatic results in 3 cases, in 19 secondary to pneumonia + influenza, Pneumococci in 14, Staphylococci in 2 cases.
and microorganisms in 3 cases; tubercle bacilli could not be found in 14 cases; sputum tuberculosis; negative results obtained in 8 cases of serofibrinous pleurisy secondary to rheumatism, heart disease, nephritis, cancer; and Staphylococci were found in 6 instances cases + 1 case secondary to infection of the lung.

Jakowski (Gazeta Lekarska 1892) found microorganisms in 23 out of 30 cases of serum effusion, and his analysis of another series of 16 cases in which microorganisms were present shows one form alone present in 34, of which 10 were Staphylococci, 2 the tubercle bacilli + 1 Staphylococci, the remaining 14 cases showing mixed infection.

Thier (Monat. Magaz. f. Lazardtuak 1895) found tuberculous bacilli present in 1 out of 12 cases of serum effusions and (Bull. de l'état 1895. 987) of 30 cases of serofibrinous pleurisy, the first examined by microscope culture, found 17 negative + 13 positive, thus:

- Bacillus Tuberculosis - 1 case
- Staphylococcus - 1 case
- Pneumococcus - 3 cases, subsequently purulent
- Staphylococcus aureus + albus - 1 case
- Staphylococcus albus albus - 1 case
- Staphyloc. albus, followed by tuberculin or inoculation - 1 case
Cases of doubtful nature, 2 cases
Micrococccus cereus, 1 case

Of 33 cases of Seraphinirum Fleurey, he found that
20—subsequently developed Tuberculosis.

Stern (Bulletin des Hopitaux 1896, 23) found from
analysis of 20 cases, 17 of which were "Prodigious"
+3 following Pneumonia

Pneumococcus 4 cases
Staphylococcus 6 cases
Eberth's Lymphatic Bacillus 1 case
Bacillus Tuberculosis 3 cases

No result in 6 cases.

Tocage (Revue de Medicine 1893, XIII, 313) found Tubercle
Bacilli at the beginning of a serous effusion which
failed to show it later, and this result throws
light on the difficulty of detecting their presence even
when the clinical evidence of Tuberculosis is strong.

Strauss (Le Tuberculose et le Bacille 1896) is of opinion
that if larger quantities of the fluid had been with-
drawn and examined, the negative results would
have been fewer, and further (diagnoses of the lungs
1896) says while in the majority of cases no
microorganisms can be found and no results
obtained from culture or inoculation, the part-
played by the Tubercle Bacillus in causation of Acute
Pleurisy in individuals of robust physique, free from hereditary predisposition is of great importance, but sufficient examination for evidence of Tuberculosis have not always been made post mortem, hence we have come to mistrust all records from which mention of such examination is omitted.

The after-history of cases of Acute Pleurisy, although details on this subject are rather meagre, tends to further the theory of the Tubercular origin of many cases, thus Seidler (Volkmer's Sammlung klin. Vorträge 1882) found that of 92 cases, only 21 were free, two years later, of all signs or symptoms of Tubercular disease, and no less than 28 had died of Pulmonary Tuberculosis.

Richthofen (Chir. experiment. 1887, p. 573) of 33 cases, 14 died of it; Bowditch (Medical Jrnl 1889, IV, 63) of 90 cases during a period of thirty years, 30 died of Pulmonary Tuberculosis; and Barr (Brit did. Journal 1870 T. 109) of 62 cases 22 had died within 6 years from the same cause.

The conclusions to be drawn from the above results may be considered fairly definite, in view of our present knowledge of the subject and the advances made in bacteriology. These I would formulate thus—

(1) Where no microorganisms can be found in the serous effusion 60% of such cases are of Tubercular
orgin, and in such "amicrobic" effusions the results of inoculation are of considerable value in demonstrating the existence of tubercle bacilli which may be only latent in their form.

2. Tubercle Bacilli can only be demonstrated in about 10% of all cases of primary pleurisy which are evidently of tubercular origin, and this can be proved from careful examination of the lungs + pleura post-mortem or from the subsequent history of the case, in many cases in which a definite microorganism other than the tubercle bacillus or no bacteria at all can be found in the effusion.

3. Conclusions from inoculation will alone be trustworthy if a large number are recorded of which a fairly constant number yield Tuberculosis in the animals; and we must remember that, in accordance with known facts about Tuberculosis in any part of the body, non-tuberculous inflammation may so damage the tissues as to render them liable to become the site of tubercular disease.

4. Tubercles of the lungs + pleura is found to develop at a later date in about one third of all cases of Acute Pneumonic Pleurisy, especially those exhibiting recurrence of the latter.

5. While the existence of tubercle bacillus in the effusion
is rare or difficult to discover from whatever reason, the presence of the Staphylococcus Albus alone is always suspicious of Tuberculosis.

2. In most cases where the microorganism found is the Staphylococcus Pyogenes, the Pleurisy is a secondary one, and only a minority of such is of Tubercular origin. If associated with tubercle bacilli it will be found that the former has been superadded to a primarily tuberculous pleurisy. Effusions arising from Staphylococci infection are more usually purulent or become so, though at first serous.

3. The presence of Streptococci Pneumococci in a serous effusion implies, in about 70%, a pre-existing or causal Pneumonia or that the so-called idiopathic Pleurisy is a primary one due to that microorganism, in which latter case the symptoms resemble those of Pneumonia as pointed out by Washbourne and Hale White.

4. In fett serous or purulent pleuritic effusion, it is rare to find Pneumococci associated with the tubercle bacilli.

5. Seroserous effusions are for the most part due in adults to tubercle bacilli or Pneumococci, in children to Streptococci or tubercle bacilli. Purulent
Effusions are in adults mostly due to Streptococci or mixed infections especially Tubercle bacilli with Streptococci, in children to the Pneumococci of Freinkel.

II. Bacteriology of Purulent Pleurisy.
Various forms of pathogenic bacteria are found in the purulent effusions, but of these three special forms, viz., Freinkel's Pneumococci, Streptococci, Pyogenic, Tubercle Bacilli, are most constantly met with in the majority of cases. These may occur in pure form, or we may find two or more of them associated together, or either of them associated with rarer forms of microorganism. Septicaemic organisms as existing in Putrid Erysipelas may coexist with any form of pathogenic bacteria. In some cases, though much more seldom than in the case of serous effusions, no microorganisms can be found, either by microscope or culture, in the pus; here again we must depend on the results, not always decisive, of inoculation, and in such cases we shall find the purulent pleurisy due to Tubercle Bacilli or Pneumococci.

In view of the more or less constant presence of microorganisms in both serous and purulent pleuritic effusions we must recognize that there are types in which
the fluid has an intermediate character; that, although in most true empyemata the effusion is purulent from the outset, there are transitional cases, in some of which the fluid at first serous becomes purulent at a later stage, in others though having the appearance of pus is not actually so. In the former the change arises either from the continued destructive action of the same organisms with toxins on the leucocytes, fibrin + connective tissue elements, or from the addition of other microorganisms constituting a "mixed infection"; in the latter as remarked by White + Wood (Therapeutic Gazette, Aug. 1891) "it is a question whether these cases in which the Pneumococcus or the Bacillus Tuberculosis only are found should be classed as strictly purulent collections, although the fluid may be turbid from admixture of fibrin + leucocytes." Whitney (in his article on Empyema in Lewis + Thompson's "System of Medical Practice" 1897) says "the exudate is not always frankly purulent in its gross appearance, indeed there is no sharp line of distinction, even microscopically, between a serofibrinous and a purulent exudate, since it is simply a question of the quantity of leucocytes.

While I do not think that the constant presence of microbes in Empyemas has been established as
possible of demonstrating, the results of all observations, pathological and clinical, go to prove that all true pleuritic effusions are the result of microbic invasion of the Pleura; the fact that we cannot demonstrate the existence of the causal microorganism in a certain proportion of cases, most of which are serious and a few purulent effusions, does not militate against this theory. From the clinical or therapeutic point of view, insofar as the bacteriological examination throws important light on the prognosis of each case, purulent pleurisy can be divided into two great classes. In the first, only one microorganism is found in the pleural effusion; this class has the greater importance and is termed "Pure" Empyema, thus Pneumococcal Empyema, Streptococcal Empyema, and Tubercular Empyema. Other microorganisms, e.g., Hesselauer's Pneumo-bacillus, Staphylococcus Albug Ebert's Typhlo Bacillus, have occasionally been found in a pure state, but the rarity of these isolated cases does not allow them to acquire a special clinical type. In the second class, there is a mixed infection, several pathogenic microorganisms being associated in the evolution of pus, thus Tubercle Bacilli with Streptococci or
Staphylococci, Streptococci with Staphylococci, Pneumococci with Streptococci, etc. To these we might add a third class, that of Pus in Empyema, in which various saprofexic organisms are found often associated with pyogenic bacteria. In the effusion, not necessarily purulent, because due to pyogenic bacteria, of Empyema, the microorganisms found may be grouped as follows:

i. Common forms, about 80%.
   - *Streptococcus pyogenes*
   - *Pneumococcus* (Streptococcus)
   - *Bacillus Tuberculosis*

ii. Less common forms, about 12%.
   - Saprophytic organisms
   - *Staphylococcus albus or aureus* associated
   - *Pneumobacillus* (Heitländer's)

iii. Rare forms, about 8%.
   - *Staphylococcus albus or aureus*, pure
   - *Typhoid Bacillus* (Ebert's)
   - *Influenza Bacillus* (Klebs's)
   - *Streptococcus* (Klebs's)
   - *Bacterium Coli* + other intestinal bacteria

iv. Extremely rare, about 1% or less.
   - *Pseudomonas, Achromyces.*
   - *Plague Bacillus, Anthrax Bacillus,* etc.
In many cases pure growths may be obtained from the effusion in Streptococcal and Pneumococcal Empyema. The two microorganisms, however, are frequently found associated with one or more of the rare forms. Tubercle Bacilli, as formerly stated, are usually found thus associated, or can be shown to be the causal organism in effusions giving negative results. In grouping the associated forms as follows, the order in which they are arranged may be taken to approximately represent the relative frequency of such associations, thus:

Streptococcus with:
1. Pneumococcus
2. Staphylococcus
3. Tubercle Bacillus

Pneumococcus with:
1. Streptococcus
2. Pneumobacillus (Friedländer)
3. Staphylococcus
4. Influenza Bacillus

Tubercle Bacillus with:
1. Streptococcus
2. Staphylococcus

The combined statistics furnished by Rosenbach, Fränkel, Weischaum, and Reimers on a total of 36 cases
according to Cestan (La Thérapeutique des Empyémas 1895,
10) gives the following result —

25% Pneumococcus
30.5% Staphylococcus
8.3% Pneumococcus associated with Staphylococcus
13.9% Staphylococcus
22.3% Tubercle bacillus + all other forms

Marfan (Les des Hôpitaux 1889, 90) distinguished only
three groups of Empyema, Pneumococcal, Pyogenic
(Staphylococcus or Staphylococcus) + Tubercular.

Courtois-Suffet (Thèse de Paris 1891), calculating from 64
cases under his own observation + that of others, finds

28% due to Pneumococcus
57% " Staphylococcus pure or associated.
14% " " Tubercle bacillus.

Kofolik (Archives of Pediatrics 1890 + 1895) by careful analysis
of two series of Empyemata in children obtained —

<table>
<thead>
<tr>
<th>MICRO-ORGANISM</th>
<th>1890 12 cases</th>
<th>1895 15 cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streptococcus</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Pneumococcus</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Staphylococcus</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Tuberculosis Bacillus</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Eberle (Thèse de Bienne 1892), of 5 cases in children.
found 13 due to Pneumococcus + 1 to Pneumococcus associated with Haemophilus; of 24 cases in adults 1 due to Pneumococcus, 2 to Streptococcus + 1 due to the association of Staphylococcus with Streptococcus Breton (Rivue des mal. de l'enfance 1892) and Cadet de Lassicourt (Acad. de medicin 1892) in 23 cases among children demonstrated:

- Pneumococcus pure in 10 cases = 41.67% 
- Pneumococcus associated in 1 case = 4.17% 
- Streptococcus in 1 case = 4.17% 
- Tubercle bacillus in 1 case = 4.17% 

Budden (New York Medical Journal 1893) found Streptococci in 7 out of 8 cases of Primary Pyogenic and Pneumococci in 9 out of 11 cases of Pyogenic following Pneumonia; the analysis of 24 cases (Bade medical Journal 1895, 7, 13) was:

- Pneumococcus in 11 cases = 45.83% 
- Streptococcus in 8 cases = 33.33% 
- Tubercle bacillus in 1 case = 4.17% 
- Various bacteria in 4 cases = 16.67% 

Thurn (Proc. magaz. for large. 1895) by bacteriological examination of 24 cases of Purulent Pleurisy found Pneumococcus in 14 cases (chiefly during an epidemic of Influenza of Pneumonia type), Streptococcus in 5 cases and Tubercle bacillus in 3 cases.

Bocour (Histoire de Paris 1895), of 10 cases in children
fruit Pneumococcus in 7 cases (27%), in 1 case the Pneumococcus associated with the Bacillus Pyocyaneus, in 1 Streptococcus, and in 1 tubercle bacilli associated with saprophytic microorganisms.

Netter (Bull Soc Med des Hopitaux, 1890, vii, 26) has furnished an elaborate analysis of 104 cases of Subacute

<table>
<thead>
<tr>
<th>MICRO-ORGANISM</th>
<th>NUMBER OF CASES</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumococcus</td>
<td>32</td>
<td>26.7</td>
</tr>
<tr>
<td>Streptococcus</td>
<td>51</td>
<td>44</td>
</tr>
<tr>
<td>Pneumococcus with Streptococcus</td>
<td>3</td>
<td>2.8</td>
</tr>
<tr>
<td>Saprophytic bacteria</td>
<td>15</td>
<td>13.7</td>
</tr>
<tr>
<td>Tubercle Bacilli</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>Staphylococcus</td>
<td>1</td>
<td>0.9</td>
</tr>
<tr>
<td>Staphylococcus with others</td>
<td>2</td>
<td>1.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MICRO-ORGANISM</th>
<th>1890, 104 cases, Per cent.</th>
<th>1891, 235 cases, Per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CHILDREN</td>
<td>ADULTS</td>
</tr>
<tr>
<td>Streptococcus</td>
<td>17.8</td>
<td>53.0</td>
</tr>
<tr>
<td>Pneumococcus</td>
<td>53.6</td>
<td>17.6</td>
</tr>
<tr>
<td>Pneumococcus with Streptococcus</td>
<td>3.6</td>
<td>2.6</td>
</tr>
<tr>
<td>Staphylococcus</td>
<td>-</td>
<td>1.2</td>
</tr>
<tr>
<td>Tubercle Bacilli, or sterile</td>
<td>14.3</td>
<td>-</td>
</tr>
<tr>
<td>Saprophytic bacteria</td>
<td>10.4</td>
<td>6.0</td>
</tr>
<tr>
<td>Tubercle Bacilli with Saprophytic bacteria</td>
<td>-</td>
<td>25.0</td>
</tr>
</tbody>
</table>
(the second series in 'Traité des Mal. de l'enfance,' Gaudin,
County of Marne, TF. 279)

Castera (La Théranophorie des Enfants. 1898, 10-12) found in
35 cases of Idiopathic or Primary Enphyema that 20
yielded Pneumococcus + 15 Streptococcus; in 22 cases
of Secondary Enphyema that 11 yielded Pneumococcus
and 11 Streptococcus + in the latter 7 were cases
consequent upon Influenza + 4 upon Acute Pneumonia.
He concludes that, in children more than one out
every two cases of Enphyema, i.e. 60%, are due
to Pneumococi, and in adults less than one out
every two cases, i.e. 40-45%, to Streptococci.

Thus, as an approximate estimation of the frequency,
per cent., of the various microorganisms in cases
of Purulent Pneumonia, the following table, which
includes both pure + mixed forms, is offered.

<table>
<thead>
<tr>
<th>Micro-organisms</th>
<th>Adults</th>
<th>Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumococcus</td>
<td>25</td>
<td>65</td>
</tr>
<tr>
<td>Streptococcus</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>Salmonella Bacillus</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Saphrogenic microorganisms</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Rarer forms</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>
TYPES OF EMPYEMA

BACTERIOLOGICAL, CLINICAL AND ANATOMICAL.

I. Pneumococcus Empyema.

The close relation between Acute Pneumonia and Pleural Empyema demands considerable consideration. In 1861 Rendall first employed the term "Pneumococcus" to pleurisy arising during or consequent upon Pneumonia, but in 1890 Petter was the first to point out that each case has its clinical aspects and propensity to the bacteriological character of the causal microorganism. And it is now evident that, many cases occur in which Pneumonia is the cause, yet the purulent effusion exhibits other bacteria than the Pneumococcus, and others in which the Pneumococci are found in pure form, without the lung tissue having at any time been affected by this microorganism. There can be no doubt that in about two-thirds of the cases of true Pneumococcal Empyema, especially in children, it is secondary to Acute Lobar Pneumonia; in adults, while some cases of true Pneumococcal infection reaching the Pleura from this source do occur, such cases either "primary" or the effusion shows...
a mixed infection or Staphylococi + Streptococi. Here I should like to point out a fact, not found elsewhere as such, viz. the greater frequency of Lobar Pneumonia in children. Bronchopneumonia, (lobular or Catorhal), frequent in the earlier years of life and in the aged, whether consequent upon Capillary Bronchitis or Acute Febrile Disorders such as Measles, is in only a small number of cases complicated by Empyema; even then the effusion will usually show Staphylococi or Pneumococi associated with pyogenic organisms, tending thus to a worse prognosis. Pneumococi Empyema is most common during the first ten years of life, one third less frequent between the ages of ten and thirty, and extremely rare after fifty (Netter).

We may distinguish three classes viz: (1) Empyema occurring with Pneumonia, "parapneumonic", (2) Occurring subsequent to Pneumonia, "post- or meta-pneumonic", (3) Occurring independent of Pneumonia, "primary"; and of these it is found that Primary Pneumococci Empyema occurs in 35% Secondary in 65%. In adults 25% in children 75% of all Empyemas exhibit the Pneumococci in Pure or mixed forms; of cases in which this microorganism exists pure 17% in adults and 53% in children.
The following characteristics of Pneumococci are here noteworthy in so far as they have relation to the action of the microorganism on the Pleura. While the Pneumococcus occasionally acquires truly virulent qualities as seen in the acute Septicaemia produced by inoculation in animals, and in its metastases or pyogenic deposits, e.g. Endocarditis, Meningitis, on the whole it is distinguished by its relative benignity in the lungs and Pleura. An organism of feeble vitality, it soon loses its virulence, for in cultivation under even better conditions of soil and temperature (artificial temperature 105.5° to 107° F) it ceases soon to grow and in about four or five days the cultures are found sterile. Moreover, when kept for 24 hours at a centrifuge temperature of 107.6° F the cultures are found to be absolutely without pathogenic power. The "capsule", which is not found present in artificial cultures, would seem to possess certain qualities in which the virulence and power of reproduction of the micro-organism itself depend. I am of the opinion that, during life in the tissues, this capsule contains elements which are essential to the reproduction and invulnerability of the organism it surrounds; that
under altered circumstances in artificial growth these protective elements, not being required, are not developed; that when these essentials (in the capsule or envelope) are diminished, used up or lost, the micro-organism itself ceases to reproduce, is soon killed by its own toxins and more readily attacked by the phagocytic elements of the blood; that the conditions determining the development, continuity and disappearance of such protective qualities in the capsule are —

1. Conditions of Soil, i.e. Nature of tissue, or culture medium in or out of animal body.
2. Susceptibility of Subject and Amount of Reaction.
3. Temperature — Flourishes best in the body at 104°F or 40°C (103°-105°F). Thus, epidemic fever with hyperpyrexia in robust individuals, if not fatal to the patient, will tend to prove more fatal to the Pneumococcus than the continuous of less reaction and lower pyrexia (102° to 105°F).
4. The association of other bacteria, especially pyogenic forms.

This theory, advanced here specially in regard to Pneumococcal Empyema, is also equally applicable to Acute Pneumonia and has also an important bearing on the existence of the microorganism in
the serofibrinous effusion of Pleurapneumonia + primary acute pleurisy.

To return, as regards the Pneumococcus, Costar (Le Théop. des Empyèmes 1898, p. 14) remarks "Its hurtful action is only a passing one, tel un feu de paille qui s'allume, flambe et s'éteint."
The Pneumococcus produces thick, creamy, greenish, nearly homogeneous, not clotted or almost colorless pus.

Soft false membranes are produced in abundance but these are more or less attached to the two layers of the pleura, rarely loose, and appear to be very easily reabsorbed. The cocci and their pus does not tend to infiltrate the lung, due probably in most cases to there having been a previous or simultaneous inflammation here; too much cannot be allowed to the statement that tolerance is established because the microorganism exists in about 60% of individuals in the healthy saliva, and even in the parenchyma of the lung.

These facts will, in great measure, explain for Pneumococcal Empyema, the comparatively slight febrile reaction or absence of "toxic" the fact that it is an easily curable affection and shows little tendency to chronicity. In the ordinary
Course of things, under appropriate treatment and frequently with no treatment, after a brief delay cure results in nearly 90% of cases. Catterall (The Throat, ed. Euphyseum 1898 p. 217) from a collected series by various observers including Schilde, finds cure resulting in 86.4% or 443 out of 513 cases.

In Pneumococcus Euphyseum it is thus possible, only in this variety to get spontaneous cure, reabsorption of the pus. There is a marked tendency for the effusion to be localized & to form a cystic, or to evacuate through a pleur-brochial fistula (vomis), and moreover in such cases (e.g. treatment) a single tapping may give complete cure.

Primary Pneumococcal Euphyseum —— while it is not infrequent for such cases to arise from a direct infection of the Pleura independent of any lung affection, the aubecedent or concurrent Pneumonia may be so slight as to escape observation or this may be masked completely by the Pleuritic signs. Again, as pointed out by Waston & Trotter, also by Hale White (Lancet 1900, 11, 1831), the onset & symptoms of such primary cases may exactly resemble those of Acute Pneumonia; Fowler (Diseases of the Throat 1895) describes such ——
Single severe rigor, high temperature 102°-103° F, pulse 120 to 140, severe pain in side, cough short dry or with slight rust frequently blood-stained expectoration, labial herpes may exist. The onset is sudden, the temperature rises sharply to 102°-105° F, remains for several days oscillating between 101° and 103° F. There may even be a crisis as in Acute Pneumonia about the 7th day. But more usually the pyrexia persists until the elimination of the pus either naturally or artificially. The effusion is often rapidly formed and large in quantity. In contradistinction to those cases where the patient is weakened by the preceding Pneumonia we may here find the temperature higher, the pulse harder, the fibrin symptoms more markedly of "stenic" type.

Secondary Pneumococcal Empyema —— This is the usual form or undoubtedly the most frequent in children. Here the purulent effusion either coincides with the onset of the Pneumonia; or makes its appearance after the acute symptoms of the latter have passed off, in which case the signs and symptoms appear at an interval of from 1 to 7 days. In many cases, in others of from 2 to 3 weeks, but even as distant as 8 months (according to Strauss) after the Pneumonic crisis. In
Concurrent cases, it may be only when examining the patient for pneumonia that we discover the existence of a Pleura-pneumonia, and this is not infrequently a serofibrinous effusion only to be distinguished from a purulent one by the state of the temperature or the use of the exploring syringe. It is especially in children that we should be on our guard for the purulent character of such an exudate, since it is in particularly in their cases that the Pleuromoccus tends to produce a purulent Pleurisy. The crisis may fail to eventuate at its usual time; the dyspnoea may continue, or increase out of proportion to the severity of the Pneumonic Signs or increase in spite of a pseudo-crisis; and the tenderness to pressure of the intercostal spaces may furnish an important clue. Otherwise the pleuritic Signs + Symptoms, though existing before the actual pulmonary symptoms have begun to disappear, may only make themselves evident after an apyretic interval of a few days and thus conform more or less to those of truly first-pneumonia type. In the typical form where the Eupyrexia makes its appearance at a varying interval after the Pneumonia has passed its crisis
and the patient begins apparently to recover from this, we find the temperature beginning to rise and ascending steadily but with variable rapidity to 103° or 102°F, preceded or accompanied by rigor, the dyspnoea and pain in the side reappeared and may surmount those existing during the pneumonia; the expansion of the affected side becoming more markedly impaired, and the patient already prostrated by the previous disease falls into an even worse condition than formerly. But the onset of the empyema may be latent, the fever of the pneumonia having passed off by crisis, or lysis in which case there should always be a suspicion of some complication, the patient does not make satisfactory progress, there may be little or no succeeding rise of temperature, and although he still remains ill we may, especially at first, be quite unable to explain the cause of this general malaise. In such cases it has been pointed out that localized areas of tenderness & pressure may be important, but in many such cases the pus may become incysted and escape on rupture until evacuated at a distant date by a vesicle or a cutaneous fistula simulating a more superficial abscess.
It must not be forgotten that the absence of Pneumococcal crisis or the recurrence of the fever may also be due to some other complication, e.g., Endocarditis, Pericarditis, etc., to some associated disease, e.g., Typhoid Fever, or to some intercurrent disease, e.g., Appendicitis.
Pneumococcal Emphysema may occur secondary to some extra-pulmonary focus of the organism but this is of rare rare; thus it may ensuing after Pericarditis, Appendicitis, Pericarditis, Pericarditis, Pericarditis, etc., with or without associated Pneumonia. That these inflammations may exist the due to the Pneumococcal of Frankel has been recently demonstrated (vide Experiments of Weillon & Brit. Bulletin Soc. med. des Affikin 1899; also Hollerton, Brit. Med. Journ. 1901, 1750, & Bryant, Brit. Med. Journ. 1901, 1167), but almost all show the association of pyogenic or other microorganisms. In such secondary cases, one would find the Pleural signs and symptoms superadded to the elevation of temperature, with or without pronounced osclillation, etc.
In conclusion, especially with reference to minor infection in Pneumococcal Emphysema, I find the following remarks of Courtois-Suffet (Traité des Pneumonies Parisien, 1892, page 150) are...
least appropriate. "During the whole course of Purulent Pleurisy due to Pneumococci, the temperature is constantly at a certain elevation above normal; and in every case where the Pneumococcus is the only organism in the pus, marked oscillations with evening rise preceded by pronounced rigors do not exist, but are seen especially in Pyogenic Pleurisy.

When these oscillations of temperature are found in cases due to Pneumococci, either there has been a secondary infection by pyogenic microorganisms when the Empyema loses its relative benignity and necessitates a different treatment, or the purulent effusion is being evacuated by vomicae (especially if the cavity refills after each emptying), a result which is most frequently met with in this form of Empyema.

The amount of effusion in Pneumococcal Empyema is very variable. But considering the more or less subacute character of the inflammation we meet with very large effusions, double Empyema is frequently of this class. There may be only half an ounce in unencysted forms, and any quantity of fluid up to ten or half pints in the pleural cavity at one time; two or three pints is a frequent amount in children.
The duration of this bacteriological class of empyema is usually shorter than that of the other varieties, any time from 20 to 70 days on an average for cases under treatment; in children probably shorter than in adults.

Hall White (Lancet 1900, IT, 1331) has recently pointed out that as regards hospital practice there has been an increase in the number of cases of empyema following lobar pneumonia; for Guy's Hospital he indicates this from statistics—

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>No. of Cases of Pneumonia</th>
<th>No. of Cases of Caseous Emphyema</th>
<th>Per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1883 - 1890</td>
<td>445</td>
<td>7</td>
<td>1.57</td>
</tr>
<tr>
<td>1891 - 1898</td>
<td>896</td>
<td>38</td>
<td>4.24</td>
</tr>
</tbody>
</table>

Thus clinically it is found that Pneumococcal empyema, especially in children, presents well defined characteristics in most cases of marked and definite onset, of short duration, of good prognosis, and of favourable termination either spontaneously or under treatment. The average mortality is never more than 15%, about 2.3% in children as compared with 25% in adults; other varieties never less than 25% average.
In accordance with the foregoing observations and results, Pneumococcal Empyema may be classified thus:

A. **Primary Pneumococcal Empyema**
   1. True primary or idiopathic.
   2. Pseudo-primary i.e. antecedent transient and unobserved.

B. **Secondary Pneumococcal Empyema**
   1. During Acute Pneumonia 
      {Pneumonic symptoms more marked
      Pleuritic symptoms more marked}
   2. Following Acute Pneumonia 
      Immediate or Continuous.
   3. From extra-pulmonary focus.

C. **Mixed Infection Empyema**
   1. Pneumococcus, the important organism.
   2. Pneumococcus of minor importance.
Case I. **TYPICAL PNEUMOCOCCAL EMPYEMA CONSEQUENT UPON ACUTE PNEUMONIA IN CHILD. RECOVERY.**

A. T., female, aged 3 years. Good family history & previous health satisfactory. Illness began with "chill," was febrile, coughing & short of breath; patient lived in a rural district in county, many miles from the nearest medical practitioner, consequently only seen at intervals of several days. Diagnosis as Lobar Pneumonia of right side. Patient to have had crisis about the 7th day. Not seen till about five days later, reports meanwhile as progressing well. On arrival here found to be changed again for the worse, there was pyrexia, dyspnea, pain in side, the typical symptoms indicative pleurisy with effusion for which treatment prescribed accordingly. Not seen till three days later when condition much worse in all respects. Pleural effusion extensive & dyspnea excessive. Exploring syringe revealed pus. Child then sent to R. H. C. Edinburgh, journey tedious & unsuitable. On examination—orthopnea & patient lying turned on to right side, cyanosis, pulse 135, respirations 28, temperature 102° F. Whole of right side of chest immobile, interspaces bulging, heart displaced to left so that apex approached the anterior axillary line. Pericardium note
fell all over right side except alone clavicle where it has tympanitic character, met with absence of vocal resonance. Do not detect any asphyxia. Aspirator with large size of trocar used; between 9 to 10 ounces of thick greenish pus withdrawn when cannula became blocked was withdrawn; this aspiration was followed by a certain amount of temporary relief, and respiratory movements of chest in upper half reappeared. Operation next morning, chloroform administered and well borne, pleuroscopy with reach of 10 inch of rib below angle of scapula and anterior to it, about 27 ounces of similar pus, two or three large masses of fibrinous material, evacuated along with numerous smaller flocculent masses. The irrigation, open drainage by short tube. Two smaller masses of fibrin and false membranes came away during subsequent dressing up next few days; discharge rapidly became scarce + tube withdrawn on 8th day. Temperature fell to normal after operation; slight welpe with rise of temperature three days later + again temp rose to 100.7 the evening after tube withdrawn. Complete recovery + discharged from hospital with wound healed three to half weeks after operation. Examination of the pus showed pneumococci in pure
form. This case exhibits a typical course in a case where the purulent effusion was large in amount, a notably satisfactory early recovery, the benefit of aspiration as a palliative of temporary remedy in the success of pleurotomy with rib resection without irradiation.

**Temperature Chart of Case I.**

| Date/Day | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| Temp. (°F) | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 |

**Case II** Suppyema due to Pneumococcus associated with Staphylococcus, consequent upon Acute Pneumonia. Errors in line of treatment. Recovery.

B.S. male, age 16 years. Family history free from tuberculosis, but mother had suffered twice from pneumonia. Had Colds and at 11 years of age, "not been strong" for the last few months. Six weeks previously had one throat + subcutaneous cervical glands from which patient recovered but remained "nervous irritable." About 4 weeks before admission to Hospital caught a chill, developed pain in side, vomiting + feverishness.
but thought to be only "mildness."

Consulted practitioner three days later who found patient with temperature of 102° F. and full development signs of Pneumonia. Treatment by penicillin, medicine etc. Crisis about the 8th or 9th day. Chickens improving slowly in general condition, but temperature varying, occasionally rising over 101° F., up till four days before admission when temperature began to rise steadily, pain in R side reappeared, dyspnea, cough etc. Sweating was a distinct feature; signs pointing to accumulation of pleural effusion, which found by exploring syringe. On admission—Patient much prostrated, dyspnea, rapid pulse & respirations, temperature 102.5° F. Lower half of right side of thorax dull on percussion with absence of breath sounds at

the lower margin just above liver, well marked ascophasy along upper margin of dullness especially beneath the axilla, respirating expansion of right side much impaired, upper portions of Right lung showed Broncho-vesicular type of breath sounds with Wrench + vocal sounds. Constipation further improved + temperature coming down by a pseudotysis. Operation on the 22nd day after the crisis of the Pneumonia, chorlumence well borne except for tendency to coughing, Pneumothorax with Vib. resarchim
large quantity of pus, rather than in density. I yellow rich green color, many large masses of fibrin, but total amount not measured. Only irrigated freely with hot boracic solution till fluid returned clear.

Drainage tube (open drainage) Patient never collapsed after irrigation which was of some duration but yielded well. During next few days there was free discharge necessitating two or three dressings each day, but temperature continued subnormal & general condition improving, except for tendency to copious sweating. There was no repetition of the irrigation which to me did not seem necessary & I am of opinion that had case been treated therefor as in Case I (i.e. without douching & removal of debris when discharge ceased in amount & became clearer) an uneventful recovery would have followed. But on the fourth day after irrigation irrigation was resumed, the case being passed out of my hands & soon after the patient began to have located rigors, sweats, & extreme oscillations of temperature. Large clots of pus & clotted material were taken.

General condition became precarious, as the temperature chart will show. I attribute this unfortunate result entirely to either the irrigation or to want of an aseptic precautions in the
The oscillation of temperature, the shiver and the general disturbance of the system could only be due to the addition of septicemic organisms or to Staphylococci (originally in pus) reacquiring their virulence. This condition persisted for two weeks, the temperature fell to normal and remained so. Eventual recovery was discharged cured nearly two months after operation.

The pus examined at time of readmission showed Pneumococci abundant, some Staphylococci. It was not examined again, so that report on its bacteriological qualities during period of illness is unworthy.

Temperature Chart of Case II.

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Case III. Pneumococcal Empyema, Encysted type.
Cured by Aspiration alone. Child.
M.S. female, age 7 years. Admitted to R.H.S.C.
Edinburgh. History of inflammation of lungs recently but not been troubling since, has cough, was feverish in the evenings, been losing weight but has no complaint of pain anywhere.

Examination of chest revealed an area of dulness in the lower part of left side of chest towards the back part of pleur, localized with absence of breath sounds, slight coughing at upper regions. Temperature on the average about 99°F with slight evening exacerbations. Cough in first degree as pleural thickening or serious effusion, hence expectorant syrup was employed till nearly a week later, when the extraction of pus show the condition to be one of empyema. Aspirator with medium sized trocar then used, + 6 or 7 ounces of typical pneumococcal pus was withdrawn — microscopic examination showed this organism in pure form. This appeared to supply the cavity completely. Temperature was over 100°F after tapping but was normal next morning, and practically remained so thereafter. Physical examination did not reveal any further reaccumulation of the effusion in lungs expanded up to chest well. Patient rapidly improved and was discharged cured after three weeks in hospital.
Two characteristic charts in Pneumococcal Septicemia.

Temperature Chart showing Course of Acute Lobar Pneumonia followed by Pneumococcal Septicemia, in which aspiration (at a somewhat late stage) failed, and accumulation of purulent effusion demanding a pleurotomy to effect cure. Adult male, 24.

Temperature Chart showing case of Septicemia complicated by Pericarditis; Pleurotomy not followed by permanent fall of the pyrexia. Child, 9 years.
II. Streptococcus Empyema

Purulent Pleurisy due to the Streptococcus Pyogenes differs in many respects from that due to the Pneumococcus, and its characteristics are more those of any supplicative inflammation at any part of the body. It is the most frequent type in adults 50-70, but comparatively rare in children 20%.

The infection may be primary, but is more often a secondary one; in the latter case the Streptococci reach the Pleura either (1) by direct extension from the lungs in cases of Bronchopneumonia, Gangrene, Infarction, etc., or from surrounding parts, thoracic or abdominal, where this microorganism has already set up inflammation with abscess formation, or (2) frequently by metastasis from pyogenic inflammation in distant parts, or (3) in cases following acute febrile disorders e.g. scarlatina or as part of a general process e.g. Septicemia, it may be conveyed by the blood and localized in a more acute form in the Pleura. In children according to Holt (Principles of Children 1899) Streptococcus Empyema frequently shows an associated Pneumococcus, and most cases secondary to Pneumonia, especially Bronchopneumonia, occur with infectious diseases. It may intervene in the course of or in connexion with a disease whose
specific cause is the Streptococcus e.g. Erysipelotis, Puerperal Fever. "That Empyema is not often -
consequent upon several diseases of Infectious char-
acter is explained by the apparent necessity, in
order to the development of Suppuratin that the
Streptococci should invade the Pleura in considerable
numbers, and particularly that there should be some
focus close to or communicating with the pleural
side where the conditions are favourable for their
multiplication. The injection of small quantities
of a pure culture into the healthy pleural cavity
has usually proved innocuous; cases have also
been reported (Goldscheider, Zeitschrift f. klin. Med. 1898)
where the presence of Streptococci in a serofibrinous
exudate has shown no tendency to transform it into
pus" (Wilder-Carrel on Empyema in Kosinis & Stempel's
System of Pne. Infection 1897).
In the Pleura, the Streptococcus infection is frequently
superadded to a preexisting inflammation due to other
microorganisms such as Pneumococci or Tubercle bacilli.
In such cases the Streptococcus seems to acquire
an even greater virulence because acting on a
previously damaged structure or because there is
a cohabitation of pathogenic microorganisms, so to
speak, complemental to each other, and leads to
a more rapid destruction of tissue elements than formation. The Empyema rapidly takes on the character of the more acute pyogenic infection; the original type, due to less noxious bacteria, is soon lost; the signs and symptoms become more aggravated; the patient is more seriously ill; the prognosis is considerably altered for the worse, and the treatment, more expediently demanded. Even in cases of small effusion, requires modification. Although in a few cases the micro-organism may have full vitality, for the most part it is characterized in any part of the body by the acute inflammatory products with rapid destruction of tissue and pus formation, and by its endurance and power of reproduction under the most disadvantageous circumstances. The resistance to phagocytes, its own toxins + various destructive (i.e. antiseptic) agents, and its long vitality are characteristic. It is anaerobic (by preference) and this in particular explains that in the Pleura it obtains a suitable medium for development. The virulence of the Streptococcus is found of varying degree, the most extreme being exhibited, on the one hand, in Acute Perforated Appendicitis, an occasional cause of Empyema or in the extremely acute + rapidly
typhoidal type of Erysipela described by Hautzel (in TAMMENS CYTOLABIA, Article on Erysipela) & Bouvrer (Traité de l'Erysipela 1889), the mildest type of Staphylococcal infection deep-seen in transient cases of facial Erysipelas.

The Staphylococcus will grow in various media and at the ordinary temperature of the body, is anaerobic at one time aerobic at another, but will resist considerable heat. It is frequently found in purulent pleuritic effusion, as in most pyogenic suppurations associated with the Staphylococcus aureus or albus. The pus may be sero-purulent in some cases, but is more very thick or viscous, yellowish gray in color with or without dyes, except gonorrheal or tuberculous.

The organism tends to penetrate deeply into the surrounding tissues, partly from this cause, partly from its great vitality; the pus produced is very persistent or readily reproduced. There are usually false membranes, numerous shreds of which float free in the Exudate, and these false membranes much impregnated with the cocci failing to be eliminated are a fruitful source of relapse. The Effusion is rarely reabsorbed, evacuated or evacuated by vomiting; and the microorganism seems capable of lying dormant
in the tissues for a long time, to regain suddenly its virulent qualities on slight provocation and to reproduce the purulent effusion. The mode of onset of Streptococcus Empyema may be acute, with severe pain, marked rigors and a rapidly ascending temperature, or it may be insidious. The temperature presents marked irregularities, and the pyrexia is often extreme.

Ludwig (Engelke, Berse, Vol. 70, 1896) has seen marked hectic fever, profuse perspiration, and sweats in cases where, on aspiration, the fluid proved to be lymphatic serum, and on the other hand has found pus where there was little or no pyrexia or other active symptoms.

When Streptococcus Pleurisy is primary (the exception rather than the rule) the onset is marked, acute and painful, the temperature rises up immediately, long and repeated rigors occur, and the effusion forming rapidly is soon abundant. When it is secondary or part of a general disease, at first it may remain masked by the local or general signs and symptoms; in such cases the effusion may be evolved slowly and insidiously, escaping notice at first.

During the course of this type of Empyema, the
The disease is characterized by marked oscillations in irregularities of temperature at a moderate elevation 101° - 103° F., preceded by a sudden rise even to 106°F. - Septic remittent fever with evening exacerbations, and by the incessant production of purulent exudate which repeated treatments fail to arrest. Along with these, several symptoms, frequently of a serious character occur viz: Rigors, Sweating, gastro-intestinal disorders especially of "colliqueuse" type, diarrhoea and vomiting, Anorexia, Anaemia. Relapses are frequent in this variety, even after operation. The patient may succumb to a general pyogenic sepsis or septicaemia and death may occur at an early stage of the disease; on the other hand, with or without treatment, Staphylococcus aureus may remain almost stationary while the patient sinks into a cachectic state, on the case becomes indefinitely chronic.

The duration is, on the average, much longer than that of Pneumococcus empyema, 2 to 4 months. In cases not infrequently become chronic. The mortality is high, 25% to 30%.
Case IV. Streptococcal Empyema, of Pyemic origin from Pelvic Abscess in Female.

This case is of interest as exhibiting the direct metastatic infection of the pleura with pyemic bacteria.

A.H. Female, 35 years. Note Purpural Cellulitis resulting in Pelvic Abscess (in the Broad Ligament) which was treated in Gynaecological Ward. Temperature has been erratic of septic type but not varying over 100.6°F. Operation: Treatment: evacuation of abscess, irrigation, drainage, packing with compress fingers. Pelvic condition made satisfactory progress, temperature reached normal by Gnosis. Patient apparently recovered & was discharged after three weeks in Hospital. Readmitted 8 or 10 days later with feverishness, pain in left side of chest, shortness of breath, rapid breathing & other signs of developing pleurisy. Two days later pleural effusion evident, temperature rising to 102°F. with marked remission of fever. Syringe recovered pus which on examination by microscope & culture showed Streptococci in pure form. Pleurotomy with resection under chloroform no irritation, free drainage by short rubber tubes. Temperature fell by Gnosis, reaching normal a week later, occasional relapses. Eventual recovery.
Case of Double Pneumococcal Empyema reported by Burns-McCosh in Edinburgh Hospital Reports 1900. Refer to on page 95 q.v.
Aspirin I gave 26 ounces, Aspirin II 26 ounces
Aspirin III 15 ounces.
III. Tubercular Empyema

At the outset we must distinguish cases of
Pulmonary Empyema occurring in subjects already affected
by Phthisis Pulmonalis from cases due to
Tubercular infection of the Pleura of primary character;
in the former case the Pleural effusion is a secondary
one, analogous to that occurring in Pneumococcus
Empyema, where the microorganisms are by no
means necessarily the same as in the primary
infection, in the latter the primary, and often sole,
focus of the Tubercle bacilli is the Pleura, to
be compared with the typical "cotton abscess" elsewhere
but not analogous (vide Eleven and Carriere-Sufflet,
Smith's "Médec. Prat."
1893, 190). The great majority of acute
or subacute Empyemata occurring in connexion with
Pulmonary Tuberculosis are non-tubercular, and
contrary to the general opinion true Tubercular
Empyema is not a common form. Meier states
that only 10% of all Empyemata exhibit the Tubercle
bacilli in pure or mixed forms; to this statement
I would here point out that there are cases where
the purulent effusion is apparently amicrobial and which
may, even in default of results from inoculation,
be classed as of Tubercular origin. In a small
proportion of cases the Tubercle bacilli are found
pure in the exudate, in a larger number we find them associated with Staphylococci or Diphteroid Staphylococci or both, while in the largest proportion purulent pleuritic effusion, whose bacterial cause is micro-organisms other than the bacillus, arises in the subject of previous tuberculous, pulmonary or elsewhere. The frequency of true Tuberculosis of the Pleura causing purulent effusion is stated as 17% for adults and 7% in children; thus I think would be more fairly stated as 10% and 5% respectively. Tubercular Emphysema may occur in the course of Acute Tuberculous pleuritis local or general of Pulmonary Tuberculosis subacute or chronic, in individuals apparently robust free from hereditary predisposition or by metastatic deposit from some extrapulmonary focus, e.g., tuberculous joints, renal urinary tuberculosis, etc. Primary Purulent Pleurisy due to Tuberculosis would seem to be a condition of considerable rarity when compared with similar primary Tuberculosis of other serous membranes such as Peritonitis, Joints. In such cases we may find no tuberculous lesions of the lungs or if found are generally of more recent or less active type; moreover these lesions may be more or more marked on the parietal than the visceral layer which would indicate
an extra pulmonary source of infection. Again, in
this type in which the Empyema shows lesions
sublymph due to Tubercle bacilli + Tubercular patho-
logical processes, the microorganisms do not reach
the pleural cavity so frequently by direct extension
from surrounding parts (as this is more characteristic
of the visceral than the parietal layer) as by direct
transit of the Serous Membrane through the lymph
and Blood Streams. It is noteworthy that Tubercular
Empyema almost never occurs in cases of advanced
Phtisis; in cases where an extensive cavity rupture
into the pleural cavity, a Pneumothorax in
which we find a truly mixed infection often of
putrid type results; in the ordinary course of
Phtisis Pneumonitis the pleural cavity would seem
to be shut off by the layers of fibrous connective
tissue which result from the chronic inflammation,
through which the bacilli cannot penetrate or obl-
iterate by chronic inflammatory adhesions over the
affected portion of the Lung. When the pulmonary
disease has preceded the appearance of the Empyema,
it may be only from a history of previous Hemoptysis,
or other Tubercular signs + symptoms that we can
have any certainty as to the true sequence of
events. Tuberculosis of the Pleura is typically
accompanying by great thickening of the mucous membrane, the surface of the nasal cavity may show a rough irregular vascular surface, films in parts or excavated by numerous ulcers of varying depth. This tubercular fleshy fibrous tissue, while in the more chronic forms leading to fibrosis, in the more rapidly advancing type tends to be very vascular, so liable to small hemorrhages & necrosis; the result of degenerative changes in this (membrana nuda) is that the effusion in place of being serous is a purulent fluid which may persist for a long time before going on to actual suppuration changes. Again there may be a constant formation of such false membranes which, underlying fibrosis change & embolism, retains the leucocytic fluid, to speak, squeezes out the serous effusion into the cavity without much tissue-debris. In other cases there may be a large quantity of serous or serofibrinous effusion, while the surfaces show little or no inflammatory thickening, ulceration or degeneration; such cases approximate the type of Acute Pneumonic of tubercular origin described above in Pathology of...
The effusion may appear purulent but so rarely so, that having the true physical qualities of pus is only found in cases where there is mixed infection essentially by pyogenic microorganisms. Sometimes almost clear, frequently turbid but never very thick, yellowish or color and often watery. May contain curdy masses or threads of false membranes. In cases where there is marked thickening with ulceration of the pleura, and in cases of long standing, especially if loculated, there is a purulent exudate consisting chiefly of tissue debris and degenerated granulation tissue in which it may be extremely difficult to demonstrate, except by inoculation, the tubercle bacillus. It appears to be more difficult to demonstrate the presence of the bacillus in purulent effusions containing associated microorganisms. Anchi (Bull. Hopital de Bordeaux 1895) disputes the necessity of the axiom that the absence of microorganisms in any purulent effusion (no serum) would argue the tubercular origin of such, for he has found dead pyogenic bacteria in empyema occurring with Pulmonary Tuberculosis.

The onset or course may be acute or subacute, such
cases, on the whole, arising from a subsequent minor infection; the course of Tubercular Empyema for se is essentially a chronic one. The duration is often very prolonged, and the general health may be fairly maintained in spite of considerable effusion provided that little or no fever or other symptoms which usually accompany Empyema occur.

Two distinctive clinical types are usually exhibited, the one characterized by acute onset, fever (with evening exacerbation), dyspnoea, pain, etc.; the other more frequent type begins insidiously and is often not recognized until fully developed there is an absence of active pyrexia, little or no local signs of symptoms, slow production of the effusion which is almost never reabsorbed, indefinite duration, and general symptoms, so frequently present in all forms of Tuberculosis, may or may be absent. Cases have been recorded where the thorax has contained an extensive purulent pleuritic effusion for many years with little or no discomfort to the patient—apparently not progressive, showing no tendency to infect the lungs or surrounding parts of the chest wall and only discovered during examination for some other disease or other site of Tuberculosis. In primitive Tuberc-
cular empyema it is found that, even although the lung is involved, the pleural signs may be the first and the only ones for a long time observed. Again, a serofibrinous pleurisy may occur in a subject of Pulmonary Tuberculosis, be treated as a "simple" pleurisy or as a Pleural pneumonia, be apparently cured or recur, without any suspicion as to the true cause, and the general health otherwise remaining unimpaired; but suddenly pyrexia or hectic develops, a necrophysis occurs or the true cause of the Pleural effusions serious or purulent is explained; Pulmonary Phthisis subacute or chronic is realized or the patient succumbs to Acute Bronchopneumonic Phthisis or even Acute Pulmonary Tuberculosis. The tendency to the excessive formation of granulation tissue with or without much necrotic change, which is characteristic of Tuberculosis in any organ, results in the case of the Pleura in serious damage to the lung tissues even if the latter remains quite uninvaded by the bacilli. The thickened membrane with its adhesions, fibrosis, and ulcerations, in addition to the effects of the effused fluid, compresses the lung and will not allow it to re-expand.
It may remain in a state of atelectasis, crushed against the vertebral column or otherwise fixed down by adhesions, and in this condition may become attacked by the tubercle bacilli, or pyogenic bacteria, and the ordinary treatment fail to ensure the reexpansion of the lung or the obliteration of the cavity. Hence the tendency for such Tuberculous Empyema to become chronic, the long duration of such cases with or without treatment, the rapid reproduction of the effusion, the liability to chronic fibrosis, the frequency of mixed infection.

Tuberculous Empyema always offers an unsatisfactory prognosis even in its earliest stages, and this is even more marked for Pleural than for Pulmonary Tuberculosis. The more favourable results are only obtained in cases where the Pleurisy is primary especially of serofibrinous character, is detected at an early stage, where active operative interference is not demanded, the patient reacts well to treatment and the disease can be controlled or overcome by hygienic, dietetic and climatic measures. But from the therapeutic point of view, as Curtis-Suffet has remarked, we must not altogether, as many authorities have done, regard Tuberculosis of the Pleura as
a case of "no 'fell traitors'. In cases where active treatment is demanded, three courses are open, viz. Aspiration, repeated if necessary; Aspiration with permanent drainage; Pleurotomy, preferably with resection. There is always a tendency to the formation of chronic fistula in all tubercular cases, and the risks of minor infection must accompany all methods, but would seem more easily controlled or obviated by the incision drainage. The results of the various methods are compared in table furnished by Cestari (in Trump in Engl. 340-26) from collected series of 168 recorded cases—

<table>
<thead>
<tr>
<th>Method of Treatment</th>
<th>No of Cases</th>
<th>Cured</th>
<th>Resulting in Chronic Fistula</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspiration (alone)</td>
<td>9</td>
<td>2 (22%)</td>
<td>5 (55%)</td>
<td>2 (22%)</td>
</tr>
<tr>
<td>Aspiration with Drainage</td>
<td>20</td>
<td>6 (30%)</td>
<td>5 (25%)</td>
<td>9 (45%)</td>
</tr>
<tr>
<td>Incision</td>
<td>30</td>
<td>9 (30%)</td>
<td>7 (23%)</td>
<td>14 (46%)</td>
</tr>
<tr>
<td>Incision with Re-section</td>
<td>103*</td>
<td>24 (23%)</td>
<td>8 (77%)</td>
<td>71 (69%)</td>
</tr>
<tr>
<td>Total</td>
<td>162</td>
<td>41</td>
<td>25</td>
<td>96</td>
</tr>
</tbody>
</table>

*6 of these cases recorded by Beek are doubtful.

Hence we see that the mortality for tubercular empyema in acute subacute forms, for untreated cases stand at 75% ; for cases under treatment by any method at 60%.
IV. Staphylococcus Empyema.

The Staphylococcus albus or aureus as the direct cause + sepsis in pure form in the empyema of pleural empyema is a rarity, but in association with other microorganisms viz. Staphylococci, Pneumococcus + tubercle bacilli (miliary or leprosy) it is frequently encountered in purulent pleurisy.

Recent pathological researches have considerable doubt on the true producing capabilities of this microorganism per se, but show that its association with Staphylococci gives a greater virulence to the activity of the latter. It is maintained that Staphylococci are not pyogenic when infecting serous membranes such as Pleura, Peritoneum or Pericardium, but Veillon (Archiv. de Path. Experim. 1897) has shown that the Staphylococcus pyogenes aureus is the chief microorganism in many cases of osteomyelitis, which may especially in children be followed by both secondary + primary types of Pyogenic Empyema.

Cases of pure Staphylococcus infection of the pleura do occur + of the two varieties of this microorganism the S. aureus may be found alone, the S. albus practically only in association with the former.

Netter (See Med. des Hôp. 1890 + Traité de Pathologie, Paris 1893) records only one case, Frankel has furnished
Some cases, Ricblanc (Rim. Méd. 1896, 152) gives a
typical case, and the whole subject with several
illustrative cases has been dealt with by Lefé et
Marchy (Des plaques purul. à Staphylocoques - Revue di Infecc.
1898). Kaposki (Arch. d'Épiderm. 1895) 2 cases from Tussulibio
says that the Staphylococci are found pure or associ-
ated in cases of Empyema resulting from penetrating
wounds, in Empyema following Broncho-pneumonia and
Werner Endocardies.

It would seem evident that, whereas the Staphylococcus
aureus is most frequently found associated with
Streptococci in true Pyogenic Empyema, or in cases
where pyogenic infection has been consistent with
superadded to purulent pleurisy, cannot primarily
by Pneumococci or Tubercle Bacilli, the Staphylococci
Albus is most frequently associated in the effusion
with Tubercle Bacilli, especially in cases of acute
serofibrinous pleurisy (v. supra. conclusion 5, pgs. 28-29).
Staphylococcus Empyema in pure form may be
considered as offering a better prognosis than
Streptococcus Empyema or that in which both are
associated, but calls for similar treatment.
The presence of the Staphylococcus in association
with Tubercle Bacilli alone in Tubercular Empyema,
in which, the effusion is frequently serofibrinous or seropurulent, while tending more to be chronic in clinical aspect, implies a worse prognosis because it is a limited affection, and necessitates treatment of a more drastic character than might be required in cases where tubercle bacilli exist in pure form. Rare in adults, 1.2% according to Kettner, is even more so in children.

I. Emphysema due to rarer microorganisms.

(1) The Pneumobacillus of Fredländer — as so frequently found associated with the Pneumococcus in Pneumonia, is also found thus in Pneumococcal Emphysema. Cases have been recorded by Lehime, Kettner, Achatz, Wolff & others, also by Sinskey and Trojan (loc. cit. des Hopitams, Feb. 1897) of Purulent Pleurisy in which this was the only microorganism found in the effusion. How far it is capable of causing pneumonia by itself is still doubtful, but it is recognized that when causing Acute Pneumonia this disease is one of greater virulence and that acute septicemia can be produced in certain rodent animals by inoculation of pure cultures. Moreover, it grows more readily in culture than the Pneumococcus of Freely, and
is said to be a "facultative saprophyte," this would explain that in certain cases the organism in focus in effusions due to Pneumococci but which have been sterilized + destroyed leaving the Pneumococci alone. Might be found associated with Strep. cocci alone but the Emphyema would tend to have the characters of cases due to the latter microorganism. Organism said to be good, even better than Pneumococci type. Treatment is on same lines as indicated for Pneumococcal Emphyema in pure or associated form.

(2) Eberth's Typhoid Bacillus — has been met with as the only cause of an occasional case of Emphyema. Silich (Bakteriol. des Emphyemas, in Berliner Klin. Wochen. May 1888) found the Bacillus in 1 out of 6 cases of post-typhoid pulmonary. Loppa & Penschi (Alteme. Z. 1890, 1892) recorded one case of Typhoid Bacillus in pure form in Emphyema. Wintraub (Berlin. Klin. Wochen. 1893, 15) another. Ackard (La Semarche Méd. Oct. 1898) gives 2 cases of such Typhoid Pneumonia, one of which was fungoid. Cases are more frequent of the association of Eberth's bacillus with Pneumococci + Strep. cocci in Pneumonia complicating Typhoid Fever. I have found Eberth's Bacillus associated with Pneumococci in the sputum of a case where the
The cause of the Pneumonia was not evident till the typical signs or symptoms of the Fever developed some days later — and such association may also be found in cases of Post TYPHOID Enlargement.

Delay in Paralysis in cases of TYPHOID Enlargement seems undesirable; Acheson (op. cit.) recommends delay in treatment till the intestinal ulcers have healed; Seward (Poppena History III 1899) says 'the patients continue in their interference in such cases simple aspiration of the pus, repeated if necessary in a few days, affords temporary relief and allows the postponement of incision + drainage for a later date.

3) The Streptococcus — Two cases of PLEURITIS Streptococca have been recorded by Paris Melville (Journal American Ind. Assoc. February 1899) + Fishor (Chicago Med. Journ) reports a case. In these the effusion was serofibrinous + it would appear that the association of pyogenic organisms is necessary for the production of a truly purulent effusion.

4) Influenza Bacillus of Pfeiffer — May in some rare cases find this microorganism in the effusion usually in association with the Streptococcus.
VI. Putrid Sputum.

The presence of Saprolegnic microorganisms in the Pleura may be brought about in two ways: either as a primary infection they reach the Pleural cavity, or they may be superadded to a previously existing purulent Pleuritic effusion. The mode of access is through the Bronchi as in cases associated with Pulmonary Sputum, Phthisical cachexia, Bronchietasis, etc., or through the gastro-intestinal tract from the Mastication in cases of Cervical Abscess, Cancer of Oesophagus, etc. and from below the Diaphragm in cases of Subphrenic Abscess, Ulceration of Stomach or Pleuritis, etc. Putrid infection may, in rare cases, reach the Pleura by external wounds, or may be superadded to chronic Tubercular cases with fistulae.

Sputum in practically never exists as a primary condition; Pulmonary Sputum, the most frequent cause of Putrid Sputum, may be an extension of putrid abscess, or is usually small necrotic areas arising from Bronchopneumonia (often tubercular) or small embolism or septic infarctions.

Various organisms very numerous microorganisms are found in the four, thus chains and clumps of bacteria, micrococci
Inflammation, leptotinum, spirilla, flagellate bodies, amebae, fungi; Bacillus coli and other intestinal forms. Pyogenic microorganisms are always more or less associated, especially the Staphylococcus aureus; and tubercle bacilli, with or without such pyogenic forms are often associated with the saprophytic forms.

The pus is usually thin and serous, but may be thick, brownish-yellow in colour, shows numerous shed of false membrane, species of necrotic tissue; may be simply fresh or have the obnoxious smell of pyocyaneus. Microscopically it shows white and red corpuscles, tissue debris &PM; lymphatic, fat globules, fatty acids & cholesterol crystals, varying microorganisms. Pneumothorax is a common complication. The patient has a tendency to become septic, even at an early stage; the pyrexia may become febrile but not necessarily from the communication of the empyema with a bronchus although septicemia are frequent; the patient may vomit or cough up much foamy pus.

The onset is sharp, often violent; the initial pain is often of great severity, remarkably persistent; the pyrexia high with great oscillations of temperature (2° or 3 degrees); but the most characteristic feature is the constitutional disturbance which is
the very rapid in development + advance, and may become markedly "typhoidal", with bronch, fever, tongue, abundant sordes, great prostration, and asthenia, stupor + tendency to delirium + coma. 

Pneumonia is always the first, death ensues in majority of cases, sometimes with great rapidity (24 hours - Bouvet, Traité de l'Empyème).

Treatment must be prompt + radical whatever the physical condition of the patient is. Pleuroscopy is universally recommended + must show very for miscellany.

Sepsis is very early with antitoxins to require both at time of operation + subsequent dressing, repeated according as the pyrexia + neural condition indicates its necessity. Sepsis seem less likely to ensue in Pueris cases than in Tubercular cases or those in which Tubercular + Empyema infections are mixed.

vide next page (50) for case of Pueris Empyema.


Following the above Bacterial + typhoidal types, we must now turn attention to some important types of Empyema whose peculiarities demand more or less on the clinical aspects and the anatomical relationships of the Purulent Effusion.
Case V. Puerperal Pyaria. Cysticercal tumour 
resulting in communication with intestine. Type 
Tubercular with Suppurative + Intestinal infection.

R. S. Male, 18 years. An ill-developed lad with 
a marked tubercular family history. Admitted 
to hospital for treatment of an abscess with two 
sinus extending over a small area on left side 
of the thorax corresponding to the 5th + 6th ribs 
partly been caused by blow or been in existence 
for two or three months, but this cause was doubted 
in view of the presence of Carcinoma detected by 
probing, his bad family history + tubercular appearance + the fact that the lesions of his lungs 
showed Tubercular signs. By operation Carcinoma portion 
of two ribs removed, cavity scraped covered 
with istomform Sponge. Wound did not heal well 
but patient sent home 4 or 5 weeks later; at 
this time there was never any evidence of the involvement of the Pleural cavity. Three months 
later patient was readmitted, the Carcinoma had 
extended below + laterally to the original focus; 
there were numerous tubercular sinuses over the 
lower half of the left side of chest rose Lyden up 
below the axilla; the pleural cavity fluid to be involved + patient's general condition was
The pus discharged was thin, bronzy, and had a somewhat offensive odor. Temperature was markedly increased and of tubercular type with cirrhotic oscillations and generally elevated. Peristalsis was somewhat extensive, irritable, and flatulence was but slight save during coughing when patient was under anaesthesia. Temperature thereafter at a lower level but not normal for some time; the discharge from the wound, which required constant dressing, became more offensive, and acquired a fecal odor. Later it was found that in the lower part of the chest the discharge at times contained faecal material mingled with a thin serous pus and blood debris, it was then evident that the purulent cavity within the chest had crossed through the diaphragm and formed a communication with the splenic flexure of the Colon. Nevertheless this fecal discharge after continuing for nearly a fortnight began to improve, fecal matter ceased to come away from the side of the chest probably because faecal material had in their growth occluded the phreno-colic communication. The pus became less offensive and more truly purulent in character, and the patient seemed to have considerably recovered as several successive health completely when he was discharged from hospital after more than two and a half months stay.
Encysted or Encapsulated Empyema.

In a considerable number of cases of empyema, the pleura does not involve the entire cavity but is frequently localized to a variable extent of it; this may result from the inflammation being localized at the commencement of the effusion, or confined by recent or old costo-plural adhesions or from the effusion at first pours into the general pleural cavity becoming thus localized by subsequent adhesions. Under this term we may include all special forms such as 'Intrathoracic', 'Empyema at the apex', 'Interlobar' etc. There may be more than one localized cavity in one or both pleurae, or again one larger cavity may be more or less subdivided into loculi by bands of pleural adhesions, this latter termed 'Multilocular'.

Encysted types more readily occur in cases where the purulent effusion is slowly evolved as in tubercular empyema or where the pleuritic exudate forms in connection with a localized area of pulmonary disease as in Pneumococcal Emphyema with Acute Pneumonia. The presence of such encapsulated purulent effusions, especially if of small amount, frequently escapes notice; the chief interests attaching to these are concerning
This sign and diagnosis, exploratory puncture may be absolutely necessary but may fail to
discover the purulent collection for various reasons.
are the differential diagnosis from localized areas
of parenchymatous lung disease such as artiotic
abscess or bronchiectasie, consolidation or gaspleum
may be extremely difficult. The localized area
of dulness, the absence or diminution of breath
sounds & voice resonance, etc. may be sufficient
but the small size of the effusion, perhaps with
contiguous areas of compressed or consolidated
lung, are apt to produce confusing modifi-
cations of these signs. The absolute dulness may
slide off above & below into zones of im-
paird percussion note with bronchial breathing,
external to this an area of tympanitic
percussion-note is obtained; this sign may
be specific but is not always so (Günther-Schei-
in Krankheit der Lunge. Thurner. 1892. 801) Encysted
Empyema is frequently found on the lateral
& posterior aspects of the Pleural cavity towards
its upper part, hence in suspicion of such we
must examine the axillary & interscapular regions.
Evacuation by minica is not infrequent, may
be the first only indication of its existence, and
in some cases, especially due to Pneumococci, a spontaneous cure may be effected by such evacuation or by reabsorption of the exudate. The prospect of complete closure of the cavity by operative treatment, (even in cases demanding extensive resection), is greater in localized than in general empyema.

Apical empyema, according to most authorities, would seem to offer a less satisfactory prognosis than encysted forms elsewhere. While it may arise from any microorganisinal cause, it is frequently associated with Apical Ptitissus, or by extension of cervical glandular abscesses. Diagnosis may be difficult owing to its simulation of pathologic conditions or cavity so frequent in this part of the lung. Treatment would be rendered difficult because of relation of the empyema to important structures or the physical difficulty of draining the cavity.

Multilocular empyema demands careful topical diagnosis to ensure in treatment the complete emptying of the cavity through way or may not intercommunicate. Cases have been recorded where one portion or less gave prevalent effusion and another portion clear serous fluid.
Velminvarteh (Étude sur la pneumonie médiastinale, 1892) says "Intrathoracic Pleurisy may produce an area of flattening which includes the whole width of the sternum and extend some distance beyond on either side; the left is the right it may displace the heart towards the left, and by pressure on the great vessels cause marked cyanosis, relaxation of the superficial veins of the chest, suffusion of the face, cold extremities and return of the upper part of the body."
If the localized character of the effusion is suspected, two or more exploratory punctures at different points should be made, and in perforating it may be well to compare the amount of fluid secured with the amount relatively indicated by previous local examination.

Mediastinal Empyema is a rare condition, seldom diagnosed during life. The purulent cavity is localized between the mediastinal parietal layer of the pleura and the internal surface of the lung behind or in front of the hilum. Thielauf and Thimiot (Bulletin médical 1876, 45, 281; Bulletin médical 1876, 18, 832) from examination of all records could only find 5 cases, 4 of which were only discovered post mortem. Bouhnot (Protée de L’Empyème 1888) records fully one case. Godet (Bull. Med. 1592, 17, 832) reports a case of left pleural empyema where the pus came across the anterior mediastinum to points in the epigastria fossa. Huber (Archives of Pediatrics 1890, 421) a case of empyema with anterior mediastinal abscess following deep-seated cellulitis of the neck in a child, who recovered two years later. Thielauf records a case cured after evacuation by Vincent. Differential diagnosis is often difficult, treatment much complicated by the fate of the fever.
Case III. Apical Empyema of Tubercular origin.

W. Male, 42 years. Admitted to Hospital for treatment of an acute Abscess in lower right hilar part of the posterior triangle of the lung on the left side. Family history bad as regards Tuberculosis. Had suffered from several attacks of inflammation of lungs. He was considered Tubercular by his own medical attendant. The right apex showed on examination many signs of Tubercular consolidation, whereas the left clavicle the breathing was of bronchial type if somewhat distant. He had double 'solar flush', had been losing flesh, feverish, worse at night, sweating. Appearance of abscess that of a tubercular cervical one as if from suppuration tubercular fluid. Temperature 103°F. Operation revealed that there was a larger cavity containing more pus than was indicated by external signs; cavity extended downwards outward and backwards. Draining free but requiring irrigation at each dressing, during which it was observed that the fluid was affected by respiration that titrated evidence coughing. Cavity closed + wound healing when patient discharged, but temperature last remained
Starting with eveny exacerbations to 10.20 F. The
signs in the lungs pointed to advancing Phthisis.
It was afterwards reported that the patient
for two months later with evidence of a
rather rapidly advancing type of Phthisis.
Was not examined for microorganisms but its
characteristics macroscopically were tubercular,
probable this Emphyema was a mixed infec-
cell with Staphylococi or Staphylocoici around
by Salvio Bacilli.
2. Interlobal Empyema

This anatomical type arises from Purulent Pleurisy localized in the Interlobal fissures of the lungs. Always a condition of great interest from a clinical point of view, its differential diagnosis usually presents difficulties; the condition may even be indiscernible with any certainty. The effusion may be, and frequently is, of small amount but may attain considerable size while completely shut off from the general Pleural space; more commonly occurs between the upper or middle lobes of the right lung; cavity may be rounded in its smaller form but when the effusion is large it tends to be flattened, following the outline of the interlobar fissure, in the latter case the lung externally may be much compressed, consolidated or sclerosed and pushed out into contact (adhesive) with the parietal pleura. The condition is of greater frequency in children than in adults, the bacteriological type is frequently Pneumococcus, + Streptocin by Vincent a common occurrence which may alone furnish the diagnosis; in some cases lead to spontaneous cure. Exploratory puncture is apt to be uncertain, especially as cavity may be very small or deep-seated; the local signs are
not to be masked by the intervening layers of lung tissue; radiography by fluorescent screen might offer some help in diagnosis. The symptoms are usually ill-defined, the onset may be acute or latent, pain or fever may be absent; but in cases where history shows symptoms (pau
drop fever, dyspnea, oscillations of temperature,
diaphoresis, and other general symptoms) indicate a supplicative inflammation of the pleura rather than the lung, and the area of dulness to percussion with absence of breath sounds corresponds to the
direction of the interlobar fissures, we may feel justified in suspecting interlobar empyema.
In treatment we cannot delay on the chance of spontaneous cure. By thoracotomy, pleuro-tomy is indicated in order that the interlobar fissure may be explored by finger, as thrombosed broken
areas evacuated, with drainage. Unless the empyema cavity lies near the surface, tapping
whether for diagnostic or curative purpose is to be deprecated because the trocar will almost
inevitably pass through lung tissue to reach the two or a septic pneumonia may ensue.
Diaphragmatic Empyema.

In this type of infected Empyema the pus is accumulated between the upper surface of the diaphragm and the lower surface of the lung, and may or may not be localized by pleuritic adhesions. It may be frequently followed from Peritonitis in the upper part of the abdomen, from subphrenic inflammation of the abdominal organs in the hypochondriac regions, especially the liver and from subphrenic abscess. Again in post-pneumonic forms it may be associated, especially in children, with a basal pneumonic; or from almost any microscopic cause the purulent pleurisy may be a primary one in this situation.

The onset is usually abrupt, and the fever prominent. The initial pain, often very severe, may be referred to a distance, but tenderness to pressure is usually localized along the costophrenic attachment. The great tenderness of the inflamed diaphragm leads to its inability for movement, abdominal respiration stops, breathing being replaced by shallow, stertorous type of respiration alone. The abdomen may be extremely sensitive to pressure and the abdominal muscles corresponding to the affected side are tense through frequently vomiting may occur, proving
important but misleading signs; the tempo often are
constipated, and delirium is not infrequent. The
physical signs characteristic of pleurisy are usually
absent because owing to the inability of the diaphragm
respiratory signs at the base of the chest are
deficient or absent. Thus special interest attaches
to the diagnosis of diaphragmatic pleurisy because
of its clinical resemblance to Peritonitis; of 5 cases
observed by Scudder (Lancet 1693) the caudal was
erraneously diagnosed as Acute Peritonitis, Gall stone,
Appendicitis. History of the case is important;
friction sounds of detectors, characteristic points of
tenderness, absence of abdominal distension, and
the more marked dyspnoea will aid the differential
diagnosis. Prognosis on the whole is favorable
except in cases arising from abdominal sources
of infection. Some cases are evacuatable by
vomiting. An exploratory puncture or incision
may be employed, taking care to enter above
the level of the 10th rib in the axillary line,
otherswise resection of a rib with exploration
of the diaphragmatic surface by the finger will be
necessary.
Case V. Putrid or Sanguinous Erysipelas.

Septic Pulmonary Infarction. Tracheo-pleuro-pneumonic Type.

P. M., Male, 20 years. Had Scarletina about three years before, complicated by Otitis Media, resulting in intermittent attacks of pain and purulent discharge from the left ear ever since. The discharge has ceased for some time, but pain in left ear left side of head was very severe. On admission to Hospital the signs and symptoms all point to the suppurative process having extended to the Mastoid Auricle. Temperature was 102.4° F. Auricle was opaque and thick, with thick pus found; deep opening into middle ear externally made and cavity irrigated with antiseptic solution packed with gauze. Temperature fell to 98.5.

Thereafter during next few days discharge continued within cavity offensively, temperature shewing marked exacerbation with copious sweathings, pain in left side of head intense. About ten days later the wound again was further opened up by trephine + the Lateral Sinus found blocked by foetid smelling thrombus + thick pus (unspecified.) At this time he complained much of pain in left side of the neck below the left ear + there was suspicious tenderness along the line of the Jugular
The patient grew steadily worse, acute rigor with sweating, temperature rising to 105° F. 106° F. Two days later he began to complain of pain in the abdomen, fever of the bowel appeared but few or no signs to be made out on examination of the chest, and abdominal unsteadily appeared. Abdominal cavity, short suppressed respirations, constipation, Patient died on morning of 6th day after second operation. Post-mortem examination revealed extensive septic thrombus of the lateral sinus extending down into the lower part of the internal jugular vein. The lungs showed numerous small foci of septic pneumonia in the lower parts of both; on the inner surface of the left lung there was found a localized pleurisy with generalized edema and marked fluid effusion corresponding to several separate infections which had here reached the surface of the lung and crossed through into the pleural cavity.

This case is interesting in view of the diaphragmatic pleurisy simulating peritonitis. The pus was not examined, but would undoubtedly have shown streptococci and staphylococci associated with various saprophytic microorganisms.
Double Empyema

Cases of purulent effusion occurring simultaneously or almost so, in both pleural cavities, do sometimes occur and have been specially studied by various observers. Chief of whom we would mention

Boyle and Pearce Gould (Transactions. Clin. Soc. of London, 174, 82) and Sutherland (Lancet 1894, 7, 1430). In the great majority of recorded cases the effusion has been due to Pneumococci and followed double lobar pneumonia. Sutherland found 14 out of 21 or 66% thus and 3 out of 21 were primary cases or 14.7%. In cases due to Bronchopneumonia or of metastatic origin both effusions may show the streptococcus, Acet (Münchener med. Wochenr. Nov. 1892) reports a case in a girl female from pericardial cellulitis. It would seem extremely rare for such cases to be of tubercular origin.

The greater, almost exclusive, incidence in children is noteworthy. But this would follow from the greater frequency of Pneumococcal Empyema in them. We may find both purulent effusions occurring simultaneously, or as is more frequent the onset for each side is at a varying interval from the other; the causal pneumonia usually occurs with an interval between the attack on
the separate lungs; but in any case a true
arrives when there is a purulent exudate
present in both pleural sacs, one of which
usually presents more urgent signs & symptoms
than the other. One or both Empyemata may
be encysted or localized by adhesions. The
temperature may not be much elevated above
the usual pyrexia for single cases but may
show more marked oscillations & larger continuities,
especially if we expect a fall of temperature
being operated on the first as we think
only affected side; naturally the dyspnoea is
further increased & may be excessive; general
toxic symptoms are frequently marked with
cyanosis & often extreme prostration. Burn-Anderson (Edin Hop. Reports 1900) has reported an inter-
case of simultaneous double Empyema in
a child of 8 years, treated by rib-resection + recovery.
As regards mortality, Sutherland had only 1 death
out of 21 cases but these were selected ones hence
this is far from the actual average; Cochen (Le
Théâtr. des Empyèmes page 263) from a collected series
of cases reported by various authors found that
the mortality was 13 out of 50 or 26%, but
Wightman & Batteu (Lancet 1895) found 9 deaths in
15 cases or an average mortality of nearly 60%. Thus the fatal risk in cases of double Empyema is always a grave one with or without treatment. In treatment, most authorities agree in recommending that the two sides should be attacked at an interval of time from each other, usually from 1 to 7 days later. Aspiration, though useful to palliate or temporise, could only be available for cure in cases where the cavity were very small & encysted; repeated aspirations are both useless & dangerous, according to Böttcher. The Septum-Drainage of Playfair-Bulain, recommended by Aust (Klinische Rts. Woch. 1871, 25, 66) Bohlandt (Deutsch. Rts. Woch. 1876), Schade (Handb. f. Spez. Thung im Irgangst & Stratzep 523, 573), are favourably considered for such cases by Costen (Le Thung. des Empyèmes 228), as also the Jackson-Kivell method of aspirating drainage after pleurotomy, might be suitable in a few cases when patient is cyanosed, prostrated & in imminent danger of death. But these methods have not been read-

- by British & American physicians. Suction, with or without resection, and open drainage would seem the right method of treatment, receiving the support of God's liber
Cautly. I ex, Cæsæl, Pech, Glasto v. e. The conclusions of England and France may be the guide to tube Sufangema in place of being a contraindication, is rather a more urgent indication for incision drainage because of the great obstacle it offers to the cardio-pulmonary mechanisms.

2. Aspiration may be suitably employed previously, in the hope of obliterating the abscess cavity and favouring the formation of adhesions.

3. It is much better to delay for some days between the two operations, in which case one ought to open the most extremely affected side, or if in doubt the left before the right because it stands in closer relation to the heart, moreover because this side heals perhaps the quicker, and to relieve the other side at the same time by one or more aspirations.

4. If it is impossible to delay owing to the urgency of the neural or local state, the two operations should be carefully aspirated some hours previous to operation on both simultaneously. Thus we may diminish the risks of shock from sudden reduction of the intrapleural tension or at the re-expansion of the lungs, thus avoiding the chief danger attending simultaneous drainage of both pleural cavities.
5. Pulsatile Empyema.

In almost all cases of pulsatile pleural effusion, in which the fluid acquires a rhythmical beat visible or palpable, synchronous with the beats of the heart, the exudate is a purulent one. Moreover, this pulsatile collection of pus is almost invariably on the left side, anterior to the mid-axillary line, and between the 2nd and 6th ribs. Of 62 cases 39 were on the left side (Cook, Post. Med. J. 1877, 509).

Attention was first directed to this new type by Hardmull in America (1844). Since then over fifty cases have been recorded and studied by observers in this and other countries. There are two varieties; in the one case the Empyema is entirely Intrapleural, usually large in amount and occupying the pleural pleural cavity. In the other when the effusion may be smaller or more localized by adhesions, the pleural abscess is found to have migrated externally to form an external tumour, more or less circumscripted in which we observe the rhythmical pulsations; this is termed "Empyema Incurvatura Pulsatilis" of the two, perhaps the more frequent variety.

In the great majority of cases the Empyema
is of some standing, and of tubercular origin even although the pus exhibits various microorganisms. Coulby (Traité des maladies de l'enfance. Paris 1893) finds that the condition is frequently but not always complicated by pericarditis. The heart is often much displaced towards the right side, pericarditis may exist. Beyond the constant relation of the effusion to the pericardium, the condition is difficult of explanation. Kraube + Bouveret (Traité de l'Enfance 1888) have advanced the theory that the necessary conditions are a considerable degree of fluid tension with a locally diminished resistance of the chest-wall; which propagation are favored by the fact that the pulsations are readily checked by aspiration of a small quantity of the effusion. Pichl, Coulby, Weil (of Heidelberg) & Stokes think the transmission of pulsations accounts for by the association of a certain quantity of air (shut off from the bronchii) with a fairly large amount of fluid. Coanda – Safft (Traité des maladies de l'Enfance. Paris 1892, p.219) suggests that the pulsations arise from their transmission through adherent lungs on a fluid bed, the condition being a chronic one the lung is retracted + bound down to the pericardium. The impulsion may be hearing, often very marked, may
It may extend over the whole left side of the thorax as in a case reported by Stokes (quoted by
Dixon - Chest Suffit - Treatment of Pulm. Pneum. pg 28); is frequently situated about the sternal angle, sometimes
just marked near the angle of the Scapula.
Sometimes pulsation may be communicated to an ordinary
case of pleural effusion, severe or pernicious by a co-
existent + adjacent Pericarditis with effusion.
In respirations we have to carefully distinguish the
cardia from Aneurism, the Pulmonary parietal
movements may resemble each other in both cases,
but in Pulmonary Empyema the movements are
less forcible + localized, thrill is absent, and
the pulsation is affected by the respiratory
movements of the lungs + chest.
Pronosis is never favorable because of the frequent
intestinal parietal and the chronic nature both
before + after Pericardium treatment.
Treatment is in no way affected by the mere
presence of the Pulmonary; incision or resection
with drainage is indicated, but we must
avoid probing or exploring too freely and change
of the cavity is extremely inadvisable; Chronic
fraktura very apt to increase.
Vomica or Pleurobronchial Fistula

Spontaneous Evacuation of an Empyema by Vomica is a more frequent occurrence than evacuation by an external or Cutaneous Fistula. The condition is most frequent in cases of Empyema type, specially Intestinal and Diaphragmatic forms; and is usually pneumococcal in origin which bacteriological type, as has been shown, shows a special tendency for evacuation of the effusion. The event may occur at almost any period in the progress of the disease, it may evacuate early but is most commonly a late phenomenon 2 or 3 months after onset or very much later. The onset of the vomica is frequently but not constantly preceded by an attack of coughing with mucous or mucopurulent expectoration, occasionally a little haemoptysis. There is frequently at the same time a sudden rise of temperature and, depending on the size of the branch of the bronchus opened into, the amount of pus in the Empyema cavity, the patient coughs up a variable amount of pus, or may vomit. The temperature may fall immediately afterwards, and then is a general sense of relief; pyrexia may reappear to oscillate for a day or two, but finally
become normal; with small localized effusions spontaneous cure may be thus effected. On the other hand there may be only a short remission of the febrile symptoms, and the pus again reforms in the pleural cavity. Again small amounts of pus may be engulphed up at intervals during several successive days.

With large effusions, or when smaller collections of pus are suddenly, thus evacuated, the occurrence may prove extremely distressing even prove fatal by suffocation; it may also be dangerous to the other parts of the same or the opposite lung by the discharge being sucked back or insufflated.

In cases where the discharge continues to come away in small amounts slowly or when the purulent exudation is excessive and continues so, especially if there are signs of insufficient outlet, dyspnoea, but fits of coughing, irregular temperature, etc., the indications are for an early pleurostomy.

When the Bronchus opens into is a large one a true Pneumothorax with ampulhmic or cavernous type of rhunit sounds may result; again, we may have to distinguish the condition, physical signs being
including, from Bronchiectasis or Pulmonary Tuberculosis, and, here we could have to depend largely on the history of the existence of the tubercle bacillus in the sputum.

Spontaneous Rupture externally may occur but is not common except in very large abscesses or long standing neglected cases. Most usually this Pulmo-cutaneous Fistula is in the 5th space just beyond the lower edge of the Rectus Major, but may occur high up or as low down as the 10th or 11th intercostal space. Simulates an ordinary cold abscess but amount of pus discharged is out of proportion to external signs. As has been shown such external abscess may subside. Otherwise various migration of the pus have been from time to time recorded; Gaillart (Chirurgia, Vienna, January 1896) has studied these records & varieties thus e.g. Sub-phrenic Abscess, Umbilical, Ipyginal. The pus may pass into the sheath of the Bowel & simulate a peritonitis abscess, or may point in the lumber region.
Complications

The following pathological conditions may accompany or follow any type of empyema, the first nine of these especially in acute and subacute forms of purulent pleurisy:

1. Compression of heart & lungs with sometimes fatal interference with the cardio-respiratory mechanism.
2. Pulmonary oedema with "albuminuous expectoration", in rapidly formed large effusion or from too rapid aspirations.
3. Thrombosis of heart or pulmonary artery.
4. Pericarditis, usually by direct extension.
5. Peritonitis.
6. Abscess in lung.
7. Septicaemia & Pyaemia.
8. Various nervous phenomena.
9. Sudden death.
10. Amyloid disease of various organs.
11. Phthisis, acute or chronic.
12. Valvular heart disease, especially malignant endocarditis.
13. Chronic nephritis.
14. Caries or necrosis of ribs & sternum.

The complications involving the nervous system etc.
during the course of and consequent upon treatment of Pleural Effusion, form a most interesting subject of study clinically and pathologically, and seem to me to be alone worthy of analysis here.

Pleural Effusion, or Empyema

First made the subject of detailed study by Raymond (Enzyén des hôpitaux) in 1875, these phenomena have since been fully examined by numerous observers of whom we may specially mention Aubriot (1878), Edmondz (1882), Bouvieret (1886), Benselme (1892), and Castan (1895). Nervous complications are always rare, but it is to be noted that the great majority of such phenomena in cases of Pleural Effusion have occurred with Empyema; only 4 out of 56 cases recorded by Benselme and Castan were cases of dry fibrinous effusion. Their occurrence is essentially associated with some therapeutic treatment, even so slight as aspiration or exploratory puncture, but a few cases have been recorded where such complications have ensued independently of any manipulation or operation. Many cases have occurred consequent upon the drainage out of the cavity.
of the Empyema with water or some antiseptic solution, a proceeding now regarded as unnecessary for most Empyemas and fraught with danger in cases where it may be absolutely necessary, but others have arisen during exploratory puncture, aspiration (while or only some of effusion removed), pleurotomy with and without resection, exploration by finger or probe, and even when patient was under an anaesthetic but the operation treatment hardly begun. Cases of sudden death in Empyema of both small large effusion in which the cause is unexplainable are doubtless due to such various complications.

In classifying the somewhat varying signs and symptoms whose origin is primarily caused by the pleural effusion secondary exhibited in the Nervous System Central & Sympathetic, I have thought best to adopt with slight modifications the classification formulated by Cestern (Le Strasbourg. des Empyèmes 1898. pg 126).

1. Transitory Vasomotor & Atrophic disturbances
2. Embolism, Cerebral or elsewhere.
3. Syncope
4. Convulsions (Plural Eclampsia)
5. Hemiplegia
6. Sudden Death
1. Transitory Local Phenomena

In a few cases it has been noted that aspiration or irrigation of the purulent cavity has produced local disturbances of the vasomotor strophic functions as patches of redness, sometimes accompanied by local sweating of the skin of the corresponding side of the thorax. In other cases, localized oedema of angio-neurotic type has occurred; this must be distinguished from the extensive oedema due to pressure or sepsis. Again, in spite of the most rigidly antiseptic precautions, following aspiration or irrigation there may be a sudden rise of temperature even to 105°F. which can only be regarded as of neurotic origin. We occasionally find that some cases exhibit a hyperaesthesia, the pain due to the disease itself or during treatment being out of proportion to the severity of the case and much greater than in similar circumstances in other patients. Such results would indicate either a neurasthenic subject or some abnormal susceptibility of the reflexes, and that the occurrence of syncope, convulsions or sudden death after aspiration or irrigation (v. infra) are also due to reflex action.
Cerebral Embolism and Abscess.

Encephalitis is rarely complicated by Pyaemia with the formation of metastatic abscess as sequela, but several cases of Abscess of the Brain have been recorded from time to time, and there are a few cases on record of Embolic Lesions elsewhere.

Thus, Vallin & de Valincourt (Thiers de Paris 1878) describe one case of Pyaemic Ulceration of the Test, Leveran (with John C. Stuart-Suffet) a case of Renal Infarction with Haematuria, Cournos-Suffet (Thiers de Paris 1877) a case of Multiple Arthritis consequent upon Streptococcal Encephalitis.

In view of the micro-organismal causes of Encephalitis the embolic theory with localization of septic emboli in the Cerebral vessels would offer a natural explanation of such Cerebral Abscess, but post-mortem examination has not always demonstrated the presence of such infarction although clinically the signs have indicated the existence of such.

The encephalitis does not necessarily follow soon after any operation on the chest, and may be quite independent of any interference with the Eosophagus (Bouweret (Thiers de Paris 1878, 30) collected 5 cases recorded by Vallin, Leveran, Robin, Brogini and Robinson, Cester add 2 cases recorded by Turnan.
two cases, one doubtfully of syphilitic origin; and 
Gütle has recently recorded another five cases. 
In 2 out of the first 7 of these six exploratory 
or operative measures had been employed, and in only 
1 was it consequent upon meningitis, in 1 it resulted 
from pleurodynia. Moreover, two of the cases (Shilko, Yelin) 
show serofibrinous effusion. In contradistinction to 
these cases of nervous phenomena of florid and 
character discussed later, pathologico lesions 
of the brain were discovered at the autopsy.

The cerebral abscess may lead to an area of softening 
with sclerosis and consequent permanent striae 
involve the face usually on the right side 
with concomitant aphasia; the Embolism shows a 
special tendency to affect the left anterior cerebral 
artery or the left carotid-striatic branch of the 
middle cerebral artery, but any part of the brain 
may be attacked. The Symptomatology is similar 
aller of other cases; in the midst of some 
fibrin symptoms the cerebral phenomena suddenly 
develop with pain in the head, sometimes syncope, 
paralysis, delirium, often with convulsions; may 
soon be coma, death or slowly recover leaving
permanent sensory-motor defects. Bouret explains the origin of such cerebral embolism as due to "the compression of the lung and heart by the plural hitui, embolises or suspend the cardiac-pulmonary circulation, thus favours the production of pulmonary thrombi", and, if, from any cause such as the relief of tension produced by aspiration or the increase of tension from injection of fluid, there is further disturbance the thrombus is liable to be detached and carried into the arterial circulation.

We must distinguish such embolic cases of cerebral abscess from cases where tubercular disease of the meninges or cerebellum have been found (as in one of Schaefer's cases No. 9. quoted by Boett. Surgery of Abst. p. 270) from cases where pyaemic embolism have taken place simultaneously in the lungs or the brain from some other focus of infection.

The mortality is high, 1 out of 8 cases results in death more or less rapidly after development of signs.

Syncopal occurring consequent upon the treatment of empyema has been recorded in upwards of 30 cases, 5 of which were by Ranceau (Annales de Medecine, 1850, page 52), 15 by various observers collected by Costeau (Le Théop des Emp, p. 126), excluding 2 slight cases recorded by Vagner (Le Bonnet, Pratique de l'Empyeme, 1852) + Verneuil (Études sur la tuberculose, 1891, page 32).

The onset is sudden + unexpected during the course of the primary operation or during the subsequent treatment. Raynaud (Soc. Méd. de Paris, 1875) has recorded one case, and Papet (Ann. des Emp, 1875, page 199) another where fatal syncopae occurred at the moment when the thorax touched the soft parts before the Pleural cavity was reached. The position of the patient during aspiration, while it may predispose to such an accident, is not an essential factor, and according to Laborde (Bull. Acad. de Médecine, May 1892) "the rôle played by the Intercostal nerves as the medium of reflex inhibition of the heart" would seem to offer an explanation in these two cases. On the other hand Syncopae has occurred during an aspirating case reported by Morton (Annals of Surgery, 1875, page 117); and most often happens during irrigating sitz at the time of Pleurotomy, 2 cases.
reported by Désplats (Boumand Médicale 1885 pp. 251) or in the weeks subsequent, case reported by Xipencourt (Archiv de Guerre Militaire 1890, p. 21), even at a considerable interval of time after as in one chronic case recorded by Cesten (Le Thérap. des Symp. 1885 p. 122) when fatal syncope from irrigatin occurred 24 years after the initial pneumotomy. In a case of Gayet (Bull. Oogi de Paris 1875, 1892) successive synopal attacks occurred every time irrigatin was employed, and death ensued 24 hours after one of these.

Sudden death may occur without the patient making a single movement or cry; but more usually he suddenly falls back, is pale, perspires, has a vacant look, the pupils are dilated, the pulse small and rapid, the respiration shallow. Under the influence of stimulating measures this apparent death may pass off, if the patient recover without any recollection of the attack, or an actually fatal result may ensue, although de Chenuville (Boumand de Suisse Romande 1885) disputes this latter.

It has been demonstrated that the use of too hot lotion or too much force used in injection especially if not sufficient free outlet for the fluid renders synopal attacks liable to ensue.

The prognosis is always serious, mortality being
as high as 80% in 16 out of 20 cases recorded.
(Case recorded by myself. See sec. 2 of this chapter, p. 127)

Syncope may be succeeded by transient attacks of
cavulsion or spasms or tremors. In such cases, they have
been collected and recorded by Boecklin and Corcan.
Cerinally, these patients in such cases would
seem better than in cases of syncope alone, for
6 of 30 cases recovered, giving an average mortality
as 33%. Spasmodic movements of one or both arms,
tremors, transient facial paralysis on the same
side as the syncope; clonic movements of the
eyeballs, conjunctival movements or strabismus have
been observed. Goodhart (quoted by Bonnet and Boecklin)
reports a case in which, an hour after the syncope,
there was angiitis-nervosa of some of the face, arm
head on the side corresponding to the syncope.
Alfred (Lancet, May 1876) a case of spasmodic
contraction of the fingers and toes with cutaneous
causomy of the face, arm, head on the side corresponding to the syncope.
Clauidt (Arch. des Séd. Milit. 1875) a case in which syncope was
followed by clonic spasmus of the arms with strabismus.
Such cases would seem, so to speak, intermediate
Convulsive Attacks.

The so-called Pleural Seizure or Salamperia. 29 cases have been collected by Barcelo and Castan, 27 of these were cases of Empyema, and 2 were cases of sarcofilious effusion (Ramande. Thes. de Sir. 1876. Salamon. Bnhr. Med. 1873, 314). Practically all the cases have occurred from irritation of the cavity, and the case recorded by Salamon was the result of a simple thoracentesis.

There may some preliminary malaise or even a sort of ‘aura’ but the attack usually begins with some faintness or pallor; the characteristic cry is seldom exhibited. Then follows suddenly the three typical stages of tonic and clonic spasms passing into coma. The clonic convulsions are always most marked on the same side as the Pleurisy, but may affect the face, upper and lower limbs separately, or both sides or all together; Reade (Clinique Medicale 1890, 7, 287) has noted them altogether on the opposite side from the Empyema. The ensuing coma may pass off with varying rapidity or a fatal result follow.

Several attacks may occur, sometimes with such
Frequency as to constitute a "status epilepticus". The pulse (150) and respirations (60) are rapid; faint may be Cheyne-Stokes respiration; the temperature may rise, especially in cases of rapidly succeeding attacks of fatal cases, even to 105° or 106°; vomiting, also involuntary passage of urine, faces may occur. True Syncope may pass to this convulsive form in all its stages, in other cases, Hemiplegic symptoms again may follow directly. In general, the total duration of the attack is rarely more than 1 to 2 days in cases that recover, but may last much longer if stupor or other mental symptoms ensue. In cases where the exit from the attack is widely prolonged, we may expect another seizure or a fatal issue to follow.

The average mortality is 25%, 13 out of the 29 recorded cases died. Where there were repeated attacks (14 cases) the mortality was 50%, but when only one seizure (15 cases) reduced to 10%.

The Convulsive Attack may be followed by Hemiplegia or Monoplegia, the paralytic, or rather paresis, being noticed first: when the patient emerges from the comatose state. (Ri. de kés. 1892)
maintained that such paralysis occurs almost regularly on the same side as the encephaloma. But only in 7 out of the 13 recorded cases was this so; certain facts, that in all cases of hemiplegia, transient paralysis, occurring as a complication of epilepsy with effusion, the paralysis was on the same side in 11 out of 15 cases or 61%. Walcher (quoted by Reverent Philo de l'Encephaloma) recorded a case where the paralysis changed sides after two successive convulsive attacks. Archangelski (Reine Revue de la Suisse Romande 1891, 309 + 340) and Trouseau (quoted by Baruel, op. cit., 31) have recorded cases of left facial paralysis alone; a case of Paraplegia affecting both lower limbs has been reported by Verneul (Studes sur la Tuberculose 1891, T, 31). There may be 'Crossed Paralysis,' also short-term movements of the affected parts.

Such parietic phenomena are usually only transient and pass off after an interval of time varying from 15 minutes (in case reported by De Montfaucon) to several days (in case reported by Verneul); but this is not always so, death may ensue or the successive attacks result in permanent paralysis. A certain amount of permanent muscular weakness often remains, but there is no tendency to the contractures or amyotrophy observed in
Hemiplegic attacks (derived Latin). Of 13 cases recorded by Jasencluq & Astan, only 3 did not recover, of those 2 were shown by the autopsy to have associated Pericarditis; hence again the prognosis is rather better than in the pure convulsive form, the mortality being 2.3%. Various mental symptoms may ensue or last for a variable length of time; there may also be transient sensory, vasomotor & trophic disturbances, these having been tabulated by Jasencluq (Paris, institut 1878, p. 370, & Med. casse. 1895, p. 208) as follows—

1. Intellectual Disorders — Tophor + Cataplexy, Delirium followed by Kalauneholi or Mania, Hallucinatris + Delirin.
2. Speech Disorders — Aphasia, in all its forms.
3. Sensory Disorders — Bizarre usually. Hemianesthesia + nearly Hyperesthesia, Visual disturbances such as Amblyopia + Amaurosis, or Contractures of the Visual field.
5. Trophic Disorders — Ulceration.

5. Hemiplegia or Paralytic Attacks.
This may occur with preliminary Syncopeal attack but without any convulsive phenomena. 5 cases.
as collected by Faureau and Costeau. The resulting hemiplegia or hemiparesis, in 3 out of 4 cases on the opposite side from the Encephalitis, is followed by contractures, spastic phenomena and muscular atrophy more or less permanent. The paralytic symptoms may be transient and pass off completely in 24-48 hours (case recorded by Langues, Arch. Med. de Paris 1846, ii. 26) up to two days (case recorded by Stuber, Arch. Med. de Paris, 1846, 768) after the spinal cord attack. The paralytic may reappear if the original stimulus (injury with virchow) is repeated as in case recorded by Archawski (Klee’s höh. de la Suisse Romande, 1874), in Djavitch (Revue de Genève 1892, v.) but it frequently remains permanent as in cases recorded by Dr. Cheneville (Revue Med. de la Suisse Romande 1888), Djavitch (loc. cit. supra).

Recovery is rarely complete, but in no case has death been recorded.

Hemiplegia, without preceding syncope or convulsions, followed by sensori-motor disturbances more or less transient may occur in rare cases. It is characterized by extreme pain in the thorax, sometimes in the limbs (hyperalgesia) with superficial anesthesia and paroxysms of pain. Hemiplegia
At hemianesthesia on the same side as the
erythema, with ocular or visual disorders occurs;
occasionally Paraplegia or Monoplegia; but always
without vasomotor or trophic disturbances.
Sanaclese has classified this type as of purely
psychic character, the "Hystero-Frenarlism" of Potain.
The death is recorded by Rubbo (quoted by Sanaclese
p. cit. 20) in case of left pneumothorax. Three
remains completely and two remained in state
for an indefinite period.

Hemiplegia, without Syncpe or Convolusions, may
be followed by sensori-motor phenomena which
appear slowly but remain permanent. The
paralytic may be monoplegic or hemiplegic but
apparently is always confined to the same side
as the erythema. 1 cases collected by Sanaclese
+ Cestan, one of which made a recovery. In
the case recorded by Weill (quoted by Connert, J.,
Cestan + Connert-Puff) there was muscular atrophy
with atactic or choreiform movements in the affected
side & limbs, and hyperesthesia of the thumb.
Lejene has recorded a case of localized patches of
Erythema, Sweating + Leucoderma, with Shooting Pains
in the affected limbs.
Rare Complications of Hernia Pyocele.

Pneumonia resulting alone has been recorded in the case by Mahieu (Lallemand Bull. Soc. Med. St. Paris 1899, 555) in another by Holmes (Journal of the American Medical Association 1871, 477) Marie in a case reported by Bade (Lancet 1895, 7, 875).

Hypertrrophic Pulmonary Osteo-artropathy, a condition connected in some obscure way with trophic changes in the nervous system, has not infrequently been found associated with Empyema usually of chronic type, vide Thorburn Brit. Med. Journal 1893.

According to Marie the true joint changes are due to an auto-intoxication by reabsorption of sterile products in the purulent pleural effusion.

Sudden Death.

A not infrequent occurrence in cases of Empyema, may occur independent of any manipulation or treatment of the effusion, but usually are the result of such or of sudden movements of the patient, especially if the effusion is a large one. Some cases doubtless result from the abeae contents being caused; while others are due to cardiac failure caused by the pressure of the fluid on the heart which is often displaced or degenerated, or by
sudden disturbances (especially the relief or increase of the intraocular tension) of the already disturbed cardio-pulmonary mechanism.

Analysis & Theories.

These nervous phenomena as complications of the myopia would seem to be more common in the male sex; most of the cases have occurred during early adult life, 20 to 30 years of age, and if 86 cases only 5 were in children below 12 years of age. While the majority of the cases have occurred during or consequent upon some interference with the myopia, it is to be noted that some have been in cases of serofibrinous effusion, and others in the absence of any manipulations diagnostic or curative. The most frequent cause is irription of the myope's eye, this was found in 27 out of 43 cases related by Franzelius, i.e. 60%. They occur unexpectedly and cannot as a rule be guarded against, but the following premonitory symptoms have been described: (1) insufficiency of the pupils, especially dilatation of the pupil on the same side as the myopia occurring at the time of irription (2) hyperaesthesia of the anterior wound (3) brittleness of the cornea,
especially the presence of capillary hemorrhage from the interior.

The relative proportions are—

<table>
<thead>
<tr>
<th>PHENOMENA</th>
<th>NUMBER OF CASES</th>
<th>CURED</th>
<th>DEATH</th>
<th>AVERAGE MORTALITY PER CENT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebral Abscess</td>
<td>13</td>
<td>2</td>
<td>11</td>
<td>84.6</td>
</tr>
<tr>
<td>Syncope alone</td>
<td>20</td>
<td>4</td>
<td>16</td>
<td>80</td>
</tr>
<tr>
<td>Syncope with Convulsions</td>
<td>9</td>
<td>6</td>
<td>3</td>
<td>33</td>
</tr>
<tr>
<td>Convulsions alone</td>
<td>29</td>
<td>16</td>
<td>13</td>
<td>45</td>
</tr>
<tr>
<td>Convulsions with Hemiplegia</td>
<td>13</td>
<td>10</td>
<td>3</td>
<td>23</td>
</tr>
<tr>
<td>Hemiplegia with Syncope</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hemiplegia with Sensory-Motor</td>
<td>4</td>
<td>1</td>
<td>*</td>
<td>0</td>
</tr>
<tr>
<td>Phenomena</td>
<td>1. Slowly developed + permanent</td>
<td>6</td>
<td>3</td>
<td>1 + 16.5</td>
</tr>
<tr>
<td></td>
<td>2. Rapidly developed + transient</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* 3 cases + 2 cases in statu quo.

Thus out of a total 99 cases, an equal number were cured or died (viz. 47) roughly 50%.

Excluding the first group whose mortality is high we find that purely functional or quasi functional disorders only result in a mortality of 12%.

Various theories have been advanced to explain the occurrence of these nervous complications of Encephalitis, the best of these are somewhat hypothetical.
The true pathogenic sequence of events has yet to be demonstrated. These theories may be grouped under three classes viz. Toxic, Mechanical, Nervous, and I shall discuss them separately.

1. The Toxic Theory.

Weariness has been brought forward as an explanation which accounts for the purely convulsive type of phenomena. But it will not explain the paralytic results; moreover, albuminuria has not been found to exist at any stage, and for the most part the symptoms and signs do not indicate a condition analogous to even the superficial type of eclampsia.

Anti-toxication, the theory advanced by Marie, Remacle and others will not explain the fact that so many cases have resulted from purely physical causes such as exploratory puncture or crqptalin. A certain amount of anti-toxication must exist or develop a malignant influence on the central nervous system predisposing to such attacks, the reflex mechanisms being more excitable and more readily responding to external influences.

2. The Mechanical Theory.

The Embolic theory has had many supporters, but in almost all cases no emboli or cerebral lesions which might be accounted for by such embolism
have been found by the most careful examination post-mortem, except in cases of Cerebral Abscess as described. In addition, the nervous phenomena are characterized by their multiple complex forms, they are changeable and transient, and do not correspond with the absolutely constant effects results of Cerebral Embolism from other causes.

The Carotid Compression theory, first promulgated by Aubertin (Thèse de Paris 1876) and Bouvet (Thèse de l'École 1880) is held to explain the Syncopeal attacks, but to fail for the convulsive hemiplegic types, and has been of late rejected in favour of the Nervous or Reflex Theory. But I am of opinion the causal element is in the production of all these nervous complications is in great measure due to alterations in the cardio-pulmonary mechanism produced by sudden changes i.e. increase or decrease in the intrapleural tension. These will have undoubtedly varying effects on the Cerebrospinal Circulation, producing transient alterations in its vascular tension, hence transient anaemia or congestion, which may result in the transient Syncopeal or convulsive phenomena on the one hand, and by consequent areas of local haemorrhage on the other hand produce the permanent motor sensory
Tracheal disorders. This theory would receive further support from the fact that most of the cases have occurred when the effusion was aspirated i.e. sudden reduction of intrapleural tension, or when fluid (or air) of case of Lamynd's Histoire de Paris 1876) has been injected either with too much force or too rapidly or with insufficient outflow i.e. sudden increase of intrapleural tension.

The Nervous or Reflex Theory.

According to this theory, the convulsive attacks caused by irritation, the syncope and the paralytic phenomena by inhibition of the nerve centres situated in the Brain and Spinal Cord. The medium of transmission of these stimulations (the centrifugal arc) have been much debated; Goldsmith maintained it was through the Vagus nerve; Raynaud and Reder through the Phrenic nerves—Labrède held that the Phrenic nerve was entirely centrifugal, but it has been since proved by Rameiga, Rymalski and Grupe to contain some centrifugal fibres—Rammé (Bull. Acad. de Médecine 1893, 700) has given to the Intercostal nerves the most prominent place as the centrifugal path of the reflex stimulations especially from their intimate connexion with the Sympathetic System & thus with the Cardio-
pulmonary Pleurases. Hence the Vagus, the Phrenic, and the Intercostal nerves associated with the Sympathetic nerves of the plexus, probably all play a part as the paths by which the Pleural irritations stimulates the nerve centers. Those who support this theory all agree that the reflex centre itself must be Bulbar in situation, for such poison alone would explain the spasm, convulsions, paralysis, vasomotor and trophic disturbances when coexistent. Hystero-traumatic (Hystria is too readily regarded as an "olla podrida" in which are mixed many different phenomena whose pathological processes we are ignorant of) and Spilsky may account for exceptional cases. Auto-infection may play a not unimportant part but it is to the Reflex Theory that we must refer many cases, while others must be attributed to sudden changes in the vascular tension of the Central Nervous System produced by sudden changes in the tension of the Cardio-pulmonary mechanism; the latter two theories combined more or less will explain other cases which neither alone would...
Case VIII. Syncope occurring during operation on Encysted Empyema. Recovery.

M.J., a female, 72 years, admitted to hospital for treatment of a small lump below and outside the left nipple, which had first appeared there about three weeks previously. Delicate-looking girl, but previous health and family history fairly satisfactory. There had been an indefinite illness with feverishness about two months before, when patient had kept in bed at home for about a week, but was not seen by any doctor, hence no diagnosis certain. The "lump" was found on examination to be an abscess which was beginning to "point" in the 4th intercostal space on the left side, thought to be a cold abscess connected with caries pleura, did not seem deep seated or the total size if it was about that of a pigeon's egg. Ruptured and discharged twelve hours after preliminary carbolic fomentation applied, probe did not detect any carious bone. Anaesthetized by chloroform, cutty opened up and explored, found to pass backward forward between 8th and 9th ribs from which it did not arise. Opening enlarged and probe passed in for distance of under two inches from surface.
The patient up to this time, i.e., for about 15 minutes, had taken the anaesthetic well, and pulse and respirations regular & good. Suddenly the breathing stopped, pulse became small & rapid, extreme pallor ensued, pupils dilated, especially the left one & death seemed imminent. Various stimulating measures employed succeeded in resuscitating patient, wound was hurriedly dressed with drains, tube & loose packing & patient returned to bed. Remainder within collapsed for several hours, but condition improved by next day. Afterwaa wound very sensitive but healed up rapidly, no recurrence of syncopeal attacks during subsequent dressing.

This was evidently a case of localized empyema in which reflex nervous phenomena resulted from the probing of the cavity. The anaesthetic had no blame in the matter unless as predisposing cause, but was being carefully, yet sufficiently, administered up to the time when probe used.

It was thought that the probe had touched the Pericardium, but it was being lightly used & its contact with the latter does not seem sufficient to have caused the syncopeal attack.
TREATMENT.

The treatment of acute and subacute empyema has been the subject of much discussion by authorities and writers on the subject, but the general opinion at the present time is almost entirely in favour of treatment by pleuroscopy (with or without resection of a portion of rib) and open drainage. Less severe methods may have their own indications in special cases, but an empyema must be regarded as demanding the treatment accorded all cases of acute abscess, viz. free incision, efficient drainage under antiseptic precautions.

We have here to examine shortly the various methods adopted with reference to the pathological and clinical types of case and the results obtained from these. Numerous methods have found temporary favour, and some of these, now obsolete, gave satisfactory results, but practically only four are now in vogue with physicians — Surgeons, British, American and Continental.

1. Aspiration
2. Syphon-drainage
3. Incision or Simple Pleuroscopy
4. Reaching or Pleuroscopy with Reaching of Rib.

The objects to be aimed at in treatment are —

(a) Removal of Effusion exerting pressure on Lung.
(b) Prevention of reaccumulation of the Effusion.
(c) Ensuring the re-expansion of the Lung and the
Illustration of the cavity.

6. Prevent deformity of the lungs or chest wall.
The means by which the reexpansion of the lungs is brought about has been the subject of numerous theories; it would seem to result from a combination of circumstances, viz. natural elasticity of the lungs brought into play by the removal of pressure, the mechanical action of the chest wall and diaphragm previously much enforced, the addition of a larger volume of blood which enters into the expanding lungs (Walter Ballantyne, Brit. Med. Journal 1875-76, 130), the circulatory contraction of the granulations surfaces and adhesions (story of Race and Sibley) and by the resulting changes in the interpleural tension due to renewed action of the respiratory pump (West - Allbutt's System of Medicine pages 344-346).

The occlusion of the Empyema cavity is brought about by drainage, reexpansion of the lungs, ascetic of the diaphragm and contraction of the chest wall.

The occurrence of artificial pneumothorax by free opening externally would not seem to have much altering effect on the reexpansion, in such cases the interpleural tension will be reduced from a plus quantity to zero, the atmospheric pressure being less than that of pus.
Aspiration — including Exploratory Puncture. The preliminary use of the exploring syringe as an indispensable means of diagnosing and a necessary process previous to further treatment is here included; the needle should be of fairly large calibre and have a sharp but somewhat truncated point; should be used at the centre of the effusion when the dulness & percussion is most marked; and we must beware of erroneous conclusions from negative results because the point may be entangled in thickened pleura or adhesions, may pass through the effusion and enter the lung tissue, may pass into a true pulmonary abscess, or entirely miss the effusion if small syrinx or deep seated. If in doubt, the aspiration may be at several places in various directions.

The pus withdrawn should be submitted to an immediate bacteriological examination, the results of which will have an important bearing on the prognosis & method of treatment to be adopted.

The use of the Aspirator as a means of cure has only a very limited range & must not be relied on solely; or again it may be useful.
as a temporary or expedient remedy in other cases. As a curative measure it may especially be tried in cases of children, especially if as is usual the effusion is due to Pneumococci & localized, but if aspiration of the purulent effusion fails to effect a cure after one, or at the most two, applications the indications are for further effort. Aspiration may be specially required as an expedient or temporary method in cases where prostration or very large effusions with dyspnea, cyanosis, or threatening asphyxia the patient cannot immediately undergo Operative Treatment; so also in cases of double Effusion when the one side is submitted to pleurisy the other may be temporarily relieved.

As a palliative, and here it may be the only treatment permissible, it may be employed in slow Tubercular Enphyma, in cases when the lungs show evidences of advanced Phthisis, and in cases afflicted by Gaemia, brain-fever, sickness, or old age.

On the whole, this aspiration is one of urgency or expediency, not of choice; and although it may avoid the risks of open incision & drainage as well as the use of a general anæsthetic, should
but be preferred to pneumootomy. As regards results numerous statistics can be found of which that by Steele (Am. Med. Assoc. 1878 — quoted above) that in an average one vig of 121 cases treated by aspirinii 23 were cured. The average accordingly may be regarded as Cure 22%, Death 22%, Recovery Pneumotomy later 56%.

II. Aspiration with Syphon Stringage.
(a) Method of Playfair-Buclin — consists in the introduction of a continuous drainage by attaching to the cannula of the aspirator a long rubber tube filled with an antiseptic solution and passing at its lower end into a vessel containing similar solution placed at a lower level i.e. under the bed of patient. The method might be tried without danger and favorable prospects of success in Erysipelas and Pneumococcus types or as a palliative measure in double Empyema or cases much prostrated from whatever cause unusual for a Pneumotomy. In Tubercular Empyema, the method is contraindicated. It is even to be dangerous. But it is unsuitable in tuberculosis, the tube is apt to be blocked or to slip out; and is not
infrequently followed by an intractable sinus or fistula, it does not afford the conditions necessary for the reexpansion of the lung. Still, it has given good results on the continent. Casten (in the Lungenkrankheiten, page 43) from a collected series of reports of cases (which must be regarded as specially selected by the observer) found that of 500 cases, 320 were cured = 73%, whereas only 50 or 27% were unsuccessful or died. Auer (Münchener med. Woch. 1891) + Röttle (Dtsch. med. Woch. 1893) have tabulated
the indications + contraindications for this method.
Indications in: (a) Cases where drainage, dyspnoeic, cyanotic etc.
(b) Double Emphysema. (c) Emphysema of benign type, idiopathic or neoplastic.
They may be employed in: (a) Acute Emphysema, if no Pneumothorax.
(b) Chronic cases where lung still capable of reexpansion.
Contra-indications in: (c) Ruptured Emphysema. (d) If any complications coexist. (e) Tubercular Emphysema.

6. Method of Sachard-Reville. — In this procedure, the drainage tube
is inserted fixed in side and the wound is then sutured up so as to close tightly round the tube; this ensures that at the outset there is complete evacuation of the lung + removal of
the false membranes (case) + masses of fibrin. The rubber tube leading from the pleural cavity is fur-
chased with a ball valve, and the distal end passes into a special flask filled with antiseptic
solution; by raising this vessel above patient-
squeezing the ball we commence an action by
which the antiseptic solution is carried into the
pleural cavity, then by lowering it below the
patient + again squeezing the ball the fluid
flows back out by syphon action. The method
is an improvement - on the last mentioned one
but even more complicated in apparatus; and
good results have been obtained, notably those
of Archaxovski (Revue Hést. de la Suisse Romande 1891, 349-
351) who got 20 cases cured out of 25 treated this
method. (Thése de Genève 1892) Hill (Bain Med. Journal
1895, 618) + Lief (Archives Émer. de Genève 1893, 42) have
also recorded successful cases. Hence out of 31 cases,
26 (83%) cured, 4 (13%) died + 1 (4%) resulting
in chronic pleurisy. Porter (Medico f. d. Zürcher
die u. Chir. 1891, 5, p. 575) reports favorably on the
method of Reillard.
III Pleurotomy — with open drainage.

In practically all Acute & Subacute Empyema, this is the operation of choice, and has yielded far the most satisfactory results both in chronic results. Simple incision of the Empyema through an intercostal space, with drainage, is doubtless the simpler of the two forms of the operation, and previous to the introduction of Pleurotomy with Rescadin gave the most satisfactory results; many still hold to this method and it may be suitable and preferable in certain cases. It would seem better in infants, although it is more the severity of the disease in the earlier months or years of life that tells against statistical account; it may be employed in cases of urgency or in cases where the patient is too weak to stand the more thorough method from whatever cause whatever it may be accomplished if necessary without a general anaesthetic. But the disadvantage resulting from the close proximity of the ribs, especially in children and the posterior part of the chest where one preferably makes the Pleurotomy, the tendency for the tube to become wedged between the ribs, the fact that without an unnecessarily large incision or from the
omission of the adjacent ribs we may be unable to introduce the exploring finger, and if necessary
irrigate with safety. the cavity may be held to
outweigh the advantages of such surgical incision.
The comparative results of the two methods as
regards prognosis & treatment may be well seen
in the following table of collected cases given by
Cochran (Re. Things. des Empyèmes pgs. 193 +215)

<table>
<thead>
<tr>
<th>OPERATION</th>
<th>NO.</th>
<th>CURED</th>
<th>DEATH</th>
<th>UNSUCCESSFUL</th>
<th>AVERAGE DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incision</td>
<td>578</td>
<td>420</td>
<td>76%</td>
<td>94</td>
<td>17%</td>
</tr>
<tr>
<td>Resection</td>
<td>687</td>
<td>586</td>
<td>85%</td>
<td>61</td>
<td>12%</td>
</tr>
</tbody>
</table>

These figures speak for themselves. Pleuroscopy with
resection of a portion of rib is the operation for
acute Empyæma & gives uniformly the best
results. Kopeik (Arch. of Pediatrics Apr. 1895) says
that for children in private practice resection
gives better results than in hospital.
I shall not enter into the details of this method
of treatment but only indicate the important
points to which attention must be paid for
best results.
As regards the influence of the age of the
patient on treatment, it is found that healing and
cure after Pleuroscopy is more rapid in children than in adults, thus for the former an average duration of 35-42% rises to 49% as the minimum duration in the latter; this result may in part measure be attributed to the greater incidence of the benign types of Empyema in children in whom also spontaneous cure by reabsorption or spontaneous evacuation is most common.

As regards the influence of the bacteriological type of Empyema on the results of treatment by Pleuroscopy, this is well indicated in Schade's tables (Newsholme & Schaefer de Padgett et Stutung):

<table>
<thead>
<tr>
<th>TYPE</th>
<th>No. of CASES</th>
<th>CURED</th>
<th>DEATH</th>
<th>AVERAGE DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tubercular</td>
<td>45</td>
<td>10</td>
<td>35</td>
<td>78% 136 days</td>
</tr>
<tr>
<td>Suppurative</td>
<td>573</td>
<td>443</td>
<td>70</td>
<td>13 5% 79 days</td>
</tr>
<tr>
<td>Suppurative</td>
<td>101</td>
<td>93</td>
<td>8</td>
<td>7 9% 66 days</td>
</tr>
<tr>
<td>Secondary or Metastatic</td>
<td>66</td>
<td>34</td>
<td>32</td>
<td>48 5% —</td>
</tr>
</tbody>
</table>

For the time of operation it is undoubted that whenever we have determined the existence of a Pleural effusion & that it is a purulent one, the earlier the operation is performed the better for the rapid & satisfactory cure.

The anaesthetic used should be Chloroform because
it excites less crypling and has a less irritant effect upon the bronchial mucous membrane than ether; in a few cases only local anaesthesia may be permissible when cocaine should be injected into the skin surface, with slight chloroform and in such cases only incision (without resection) should be attempted. There is much unnecessary fear in the administration of general anaesthetics, the dangers in cases of operation for Emphysema are not much worse than for any other operation in which the action of the lungs is least embarrassed; the dangers of even fatal syncope which may occur so much more likely due to reflex nervous stimulation produced by the incision, exploration or resection than to the effect of the chloroform in cases of Emphysema.

The position of the patient is an important item; he must not be turned much towards the sound side so as to interfere with the action of the only functioning lung. The position recommended by modern surgery (i.e., Fowler's position, Diseases of the Chest 1895) is that the patient should be kept lying flat on his back, the affected side should project over the edge of the table; the operator perform from below; moreover this
position ensures opening the pleural cavity at the most dependent part so that all the air can escape & be easily caught in a vessel placed underneath for this purpose.

The position of the incision should be parallel to the ribs, corresponding to the 9th rib at a point mid-way between the posterior axillary line & the angle of the scapula; this is the most dependent part & allows the best drainage whether the patient is lying down or sitting up. In children the 9th or 10th rib should be attacked only to break the height of the diaphragm in them.

About 1½ inches of rib should be removed, preferably subperiosteally, not because the flap may be thus lifted up later by new bone but in order that the incision into the pleural cavity may be made at a point corresponding to the middle of the rib & thus best satisfactorily avoid entering the intercostal artery.

The fingers should be introduced to explore the cavity & if necessary by blocking the thoracic control the too rapid exit of the effusion especially if large tender pleuritic pain; you can thus also remove clots masses of fibrin, can
Assure oneself that the Emphyema has been all erupted i.e. there is no loculus not reached, and also ascertain if the lung is expanding well. It is wise to break down adhesions.

Irrigation of the cavity is quite unnecessary, save in tuberculous types, either at the time of operation or subsequently; in most cases it serves no useful purpose and even dangerous; and the results are not so good with as without it as shown by Pumpeberg (Berliner klin. Wochen. 1890. 34. 17) & Hopfille (Ludw. Berlin, 1892)

<table>
<thead>
<tr>
<th>IRRIGATION</th>
<th>CURES</th>
<th>AVERAGE DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>96%</td>
<td>52 days</td>
</tr>
<tr>
<td>Single, at time of operation</td>
<td>78%</td>
<td>88 days</td>
</tr>
<tr>
<td>Daily—repeated</td>
<td>30%</td>
<td>111 days</td>
</tr>
</tbody>
</table>

Drainage should be by short red rubber tubes, 2 or 1½ inches in length just sufficient to project slightly into the pleural cavity, with flange or other attachment to prevent it being drawn into the chest. A large tube is bad except perhaps in cases where there may be necessity for a constant asperation. When such a tube with lateral perforations may be carried from one opening to another but should be kept thus only for the
The tube of removal of this drainage tube is determined by the discharge becoming serous and the temperature remaining normal, the lung well expanded and the external wound contracting; in children it may frequently be removed about the 14th day after operation, in adults usually on the 21st or 26th day, for ordinary uncomplicated cases. Several types of case.

Valved drainage tubes such as those of Hartley or Hutton are troublesome, easily blocked if too thick or there are many clots or false membranes and the necessity for securing the plug at the upper portion is a great handicap and to insure the exclusion of air entering from external surface the two lucerne of the valve ensures, is irksome to the patient and embarrasses the respiration of the chest. Usually.

Open drainage is best; the tube is tied with antiseptic suture loosely placed over its mouth, wool arranged so as to avoid direct pressure on exit of tube (this creates abundant supply of absorbent wool) bandage applied not too loosely but sufficiently firm to ensure
the proper & constant application of the dressing. If necessary required, best to use a continuous supply of weak antiseptic lotion, and I think Perchloride of Mercury 1 in 5000 or 8000 best, the antiseptic qualities of Boracic or any so-called innocuous antiseptic are useless to overcome the virulent microorganisms whose presence demands a more thorough antiseptic treatment.
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