Thesis

George Porter

1895
To the

Dean of the Faculty of Medicine

and the Senate Academicius of the

University of Edinburgh

Sir & Gentlemen,

As a candidate for

the degree of Doctor of Medicine-

I beg to lay before you this

thesis on:

"Empyema in Children"

with special reference to its

surgical treatment

In this thesis I shall confine myself to cases of empyema occurring in children—applying the term—children to those between infancy & twelve years of age.

Suppurative pleuritis is one of the common wasting diseases of childhood — & according to some statistics is more prevalent
in the first five years of life than at any subsequent time (Bouveret, Traité de l'Emphyème, Paris, 1888).

From an examination of 428 cases of Empyema occurring in children under twelve years of age - 320 or three quarters were under six.

In children the pleura seems to have a tendency to form pus (Goodhart), who found in 149 cases of pleurisy with effusion that 78 were purulent. (Goodhart - Diseases of Children 5th edition - p. 365).

In 43 of 51 Carmichael's cases, 19 were purulent. (Disease in Children p. 277).

In a series of 108 consecutive cases recorded by Donkin with liquid pleurisy - he found that by far the larger number were empyemate. He also says that among liquid effusions occurring in childhood,
...following on or connected with broncho-pneumonia or pneumonia, empyema is about twice as frequent as the various pleurisy. (The Diseases of Childhood p. 389.)

In the records of the cases at the Great Ormond Street Hospital for Sick Children — I find that in 229 cases of pleurisy with effusion no fewer than 157 were parietal.

These figures may not however quite fairly represent the relative frequency of empyema to simple pleurisy with effusion in childhood, as one sees the worst side of all diseases in a hospital.

Dr. Goodhart (cf. cit. p. 385) points out the large preponderance of left-sided empyema over right-sided — his figures are: right 18, left 59.

I have not seen this fact noticed by any other observer. The figures I have collected are as follows: 148 cases of empyema.
right-sided 58 - left-sided 90.

These results are not as striking as those obtained by Dr. Goodhart - but they confirm his statement sufficiently. I think it would be worth recording a modification.

Causation.

I will only discuss the causes that have given rise to most differences of opinion.

Whether a simple pleurisy with effusion in a child is a frequent cause of empyema - if it is not soon removed artificially or naturally - is a much disputed point.

Dr. Eustace Smith inclines to the view that it usually does - he says: "In childhood the effused fluid becomes purulent at an early period. (Disease in Children, 2nd edition, p. 469.) Again: "The effused fluid is at first yellowish or greenish, stramo-
-parent - but it soon becomes turbid and opaque, is in children very quickly prevalent. (P. et al. 492). On the same question "if the effusion continues for two or three weeks, the fluid usually becomes prevalent (P. et al. 492).

At the opening address in the Section of Diseases of Children at the Annual Meeting of the British Medical Association at Bristol, Dr. W. H. Dickinson referred to "the comparative readiness with which the pleura undertakes "suppuration in early life, so that what in a grown person would eventuate only in a dry pleurisy or serous effusion, gives rise to empyema in a child. (Bart. Med. Journal. 25. Aug. 94).

Dr. Goodhart says: "Some hold that a serous effusion is the origin of "most of the empyemata, I have "upon that belief an argument in favour of early paracentesis in the former."

"I think the balance of probability is
against this view, I am in favour of "empyema commencing as such, except in occasional instances." (Op. cit. p. 372.)

Under another heading he goes on: "Some think that a serous pleurisy is liable to pass into an empyema if the serous effusion is copious, or not removed early; but while allowing this to be possible, I know little to support it. Indeed, clinical facts all seem to me to prove that it is quite rare." (Goodhart Q. J. cit. p. 375.)

Dr. Carmichael thinks "that about one-half of all effusions in children are purulent, or become so within a short time. (Op. cit. p. 277.) He also says "The effusion may be purulent from the first, or the formation of pus largely depends, no doubt, on the intensity of the inflammation."

"In some cases the effusion is serous afterwards becomes purulent." (Op. cit. p. 278.)
Dr. Ashley Wright's book I find
"An empyema, as a rule, is an
empyema from the first, at least
the fluid is turbid-looking at first;
in other words, it is thin pus, later
it becomes thick pus."
(The Diseases of Children - p. 249.)

Dr. Donkin believes "that very many
empyemateous are such from the
beginning, purulent conversion
of a serous effusion being
certainly rarer than is generally
believed."

"A serous effusion may remain
serous for an indefinite time."
(Ibid. cit. p. 384.)

In the article on empyema by Dr. Labot
"Dr. Keith's Cyclopaedia of the Diseases
of Children" it is stated that
"Pleuritic effusions are far more apt
to become purulent in children
than in adults" (p. 705.) and
"that an inflammation of the pleura
may be purulent from the start,
but far more commonly it begins
with a serous or a sterile purulent
fluid, and this changes more or less
rapidly or insidiously into pleu.

While I am not prepared to state that once a serous pleurisy always a serous pleurisy, yet I have seen cases, where the fluid remained clear for many weeks in spite of repeated aspirations.

One case in particular,—remember in Dr. J. Barlow's ward at Great Ormond Street. The boy was aspirated many times, so the fluid remained quite clear for at least six weeks, when I lost sight of the case, as he was sent to an asylum.

Dr. J. Barlow, in discussing this case, referred to similar chronic serous pleurises, he had seen in children, in which the fluid continued to accumulate although frequently aspirated.

On the other hand it would not be hard to quote many cases in which the fluid withdrawn from the chest on one occasion was clear.
on a subsequent aspiration
purulent - is this in spite of the
fact that the needle was sterilized
thoroughly & the skin cleansed
most carefully.
But it is said that serum pleurisy
never become purulent unless
they are explored or aspirated -
this throwing the blame on the

This statement is incapable of
proof or disproof, & therefore does
not count for much.
I hold that a serum pleurisy
may become purulent - yet
I do not agree with those who
say that this is practically always
the case or even common.

The most common antecedents of
emphysema are the specific fevers
- measles - scarlet fever - whooping
cough - with the associated
conditions of the lungs - e.g. pneumonia,
bronchitic - bronch - pneumonia.
while of these conditions is most
commonly followed by emphysema
is - I think impossible to state.
In the Hospital for Sick Children -
Great Ormond Street - however measles in by far the larger number of cases - empyema is preceded by measles - scarlet fever causes comparatively few - but it must be remembered that cases of scarlet fever are not admitted into this hospital - but are now invariably isolated in special fever hospitals.

Empyema is stated by most authorities to be commonly caused by tubercle.

Dr Carmichael mentions tuberculosi as the third commonest cause of empyema (Op. cit. p. 292) and Delattre agrees with him (Teaching wards p. 905). Dr Donkin says "tubercle is a very frequent cause of empyema" (Op. cit. p. 281).

I do not believe that tubercle is a common cause of suppurative pleuritis - I think the error has arisen from post mortem evidence. Earlier cases when it was not the common custom to
drain empyema properly. A aspiration alone was performed.
The operation was often repeated several times, after a protracted illness the child eventually died. Tubercle being found in some parts of the lung post-mortem.

Knowing how readily a debilitated child becomes infected with tubercle - it is not extraordinary that a damaged lung should become the seat of this disease, and necessarily hasten the child's death.

Dr. Barlow, Flutton & Parken state that they have met with cases where they believed a tuberculosis was secondary to a chronic empyema.

My contention is supported by the results of post-mortem examination in cases dying of empyema, during the past few years - at Great Portland Street - where it is quite uncommon to find tuberculosis in these cases. The average being less than one a
year - last year (1894) there was not a single case of tuberculosis in patients dying from empyema - none of the patients discharged from the hospital showed any symptoms of this disease during the same period.

And I think that the fact - as far as my reading goes - that the Bacillus tuberculosis has never been found in the pus withdrawn from an empyema bears out this statement - although it is said, that where no microorganisms were found in purulent fluid - the cases were probably tubercular. Those consulted Dr. Sims Woodhead on this point.

Dr. Sutherland (Annat 9, June 94) in discussing the cause of empyema from cases occurring in children notes "that tuberculosis does not seem to play an important part as is mentioned but once in the list".

Although the list included the statistics of unilateral empyema given by Adam (Archiv f. Kinderheilkunde. Band XIV. Heft 2, 1869).
In twenty nine fatal cases of empyema collected by Mr. J.P. Wightman - tuberculosis is neither mentioned under the heading "cause of death" nor under complications - although post mortem examinations were made in twelve of these cases. (Janet. 5; May. 94.)

I do not therefore think that tuberculosis is a common cause of empyema - indeed I believe it is rather a rare one - & I expect in the future to see the statements I have extracted from the leading authorities, altered.
In considering the question of the physical signs of empyema in children, I necessarily confine myself to the most interesting symptoms.

The empyema was pointing in eight out of ninety-one cases—a symptom of which I give later on.

In one 2nd interspace anterior right side.
In one 5th " Pulse tend right "
In two 5th " just outside nipple line left."
In one 6th " " left.
In one 7th " Anilla left side.
In one 8th " Anilla left side.
In one 9th " Post. Axill line right side.

Attention may be called to the fact that the pointing did not in any case simulate a lumbar or psoas abscess from the pus burrowing through the abdominal wall. But in one—where it pointed in the 5th interspace on the right side—it closely resembled an abscess of the liver.

The intercostal spaces may be
Obiterated or bulging, but I do think they are commonly so, and the fact that the affected side may be retracted must not be overlooked.

For as Dr. J. Barlow has very justly pointed out, the fact that retraction of the side has occurred is by no means a positive proof that absorption has been completed.

On the contrary, if the deformity continues without improvement, it rather tends to suggest the possibility of some unabsorbed purulent matter remaining at the base of the lung or between the lobes.

And on this subject Dr. Goodhart says: "Bulging of the ribs is said to be an indication of the existence of pus, but it is common to find the affected side natural, smaller, or distended, rather than over-distended" (op. cit. p. 369).

Personally I have seen two cases, where this sign was of any value.
Dr. E. Smith points out that
"Besides the general distribution of the dullness, the alteration of the percussion note on change of position is a valuable sign of fluid in the chest. (Cf. cit. p. 472).

I attach most importance to the feeling of resistance while accompanies the absolute dullness in these cases - as the pus is often localized, i.e. movement can take place if this obtains.

I do not think that quite sufficient stress has been laid on the peculiar auscultatory signs of pleurisy with effusion in children - whether the fluid is serous or purulent.

The character of the breathing is commonly "distant" bronchial - but loud bronchial or tubular breathing may be heard below the level of the effused fluid -

"This character of the respiratory sound as Dr. E. Smith points out is not confined to cases where
the lung is consolidated from pneumonia, for it is often present when the temperature is normal (cf. cit. 474).

Dr. Wilks lays it down as a rule that local dullness with distant bronchial breathing or absence of breath sounds, persisting after an inflammatory attack in the chest, indicates the presence of a local empyema.

Dr. Donkin says "Very often bronchial breathing, sometimes in a most marked degree, is heard all over the area of the effusion" (cf. cit. 383).

It is hardly possible to overestimate the value of this physical sign - if bronchial breathing is heard in a child the possibility of fluid should always be thought of.

Displacement of the liver, often, especially in the heart is also a most important physical sign of fluid in the chest.
The heart's apex beat is nearly always displaced - even when a small amount of fluid is present in the area of cardiac dullness. in children, can usually be made out in an abnormal position.

Dr. Johnstone rightly states that "In all pleural effusions, where the liquid is free or nearly free in the cavity, marked displacement of organs is more common in children than in adults." (Cf. cit. p. 382).

This sign is, of course, not invariably present - but it should be always looked for carefully.

Dr. Carnichael records a case in which "the effusion was localized where this sign was absent, although the fluid was on the left side." (Cf. cit. p. 279).

Temperature.

"In many children with a chest more than half full of purulent fluid the temperature is normal. (C. Smith, op. cit. p. 472.).
"I have records of a whole series of cases of empyema in children between 4 and 8 years of age where there was absolutely no fever. "In a few indeed, the temperature varied between 97.7 and 98.8. ""
(Dr. E. Hinch - Lectures on Children's Diseases - New York: Van Leavenham Society.

p. 431.) -

"The distinction between a serous and a purulent effusion is very difficult."

No information can be gained from the temperature, for this may be elevated or not without reference to the character of the fluid. It is often high with a serous effusion as perfectly normal with a large purulent collection in the chest. (E. Smith Jr. cit. p. 288.)

"The temperature affords no certain indication, yet when it is abnormally low the probability is in favour of purulent effusion, in obedience to the "temperature law" in most chronic debilitating conditions in children; large collections of pus in the child's chest, like chronic
abscesses in other situations, being often associated with vital depression and low temperature.

In fourteen cases of empyema in hospital, five had normal or subnormal temperatures, five were noted as slightly pyrexial, seven as pyrexial."
(Dr. Carmichael, F. cit. p. 298).

"Though the temperature in empyema is not to be trusted implicitly.
As a rule, it rises by night; I have noticed that the suppurative fever is apt to register with particular deliracy a re-accumulation when once the pus has been removed by operation. It is by no means uncommon to find oneself in considerable doubt as to the presence of pus in empyema which has not been tampered with—but when once the pus has been evacuated, should it again re-accumulate, the thermometer will indicate the fact with the most sensitive accuracy.”
(Dr. Goodhart, F. cit. p. 36).

My own experience coincides with the authorities quoted—more or less—
rig that the temperature as a rule is not to be trusted in encephalitis of childhood.

Indeed, in all diseases of childhood, it is often very uncertain — is not nearly so reliable as in adults. Still in the cases I have seen the temperature was usually raised before operative interference. In nearly every case it was decidedly irregular — generally higher at night. After the pus was removed — if this was done thoroughly, the temperature fell almost always to normal or sub-normal within 24 hours, it became regular.

But any re-accumulation of pus — by closure of the wound, or omitting the tube too soon — was invariably followed by a rise or by irregularity or both on the recording chart. Therefore, after the purulent material has been once evacuated — the temperature is a very valuable sign — as it shows certainty.

1. That the pus has been all removed.

2. That it has not re-collected.
According to Dr. Y. Barlow, marked clubbing of the finger ends is never the consequence of a serous effusion.

The same authority has said "If a child be seen with general pallor and finger clubbing, one ought to think of empyema rather than the other causes of clubbing - viz., chronic bone disease, bronchiectasis, or congenital heart disease" (Barlow).
Diagnosis

Diagnosis is undoubtedly very difficult in many cases, and pleural effusion (especially empyema) is one of the most frequently overlooked diseases in children - so in hospital practice at any rate - it would not be difficult to record cases that have been missed.

"There are no useful distinctions, as regards physical signs, between pus and serous."

"The question can only be settled by an exploration with a hypodermic syringe, a trephing operation, which does no harm. The chest must be carefully examined beforehand, and the needle passed in wherever it appears that there is fluid, whether this be at the base, as is most common, or in the anilla, or even at the apex."

(Dr. Goodhart. F. cit.: p. 373.)

Henoch (F. cit. p. 431) states that "the only certain means of recognising the character of the effusion is..."
The difficulty of diagnosis is increased by the fact that a large number of effusions are encroached - especially when purulent.

Dr. Donkin describes a case in which he drew serum off by one puncture after another on the same side of the chest, at the same sitting. (cf. cit. p. 383.)

It is undoubtedly also very hard in many cases to distinguish empyema from other conditions of the lungs and chest wall that simulate it closely or are co-existing with it, such as pneumonia, collapse, thickened pleura, tuberculosis. In many every case where there is the slightest doubt an exploring syringe should always be used as need arises. The syringe can be partly withdrawn & exploration made in several directions from one puncture.
According to Dr. Donkin—"In cases of some standing the diagnosis between thickened pleura alone, or the same condition with pus collection somewhere, is quite impossible without exploration. (Cited p. 387.)"

It is generally stated that a hypodermic syringe should be used for exploration—so if no other instrument is available—an other course can be adopted—so a few hypodermic syringe is better than nothing.

But I would lay stress on the need for a regular exploring syringe—that can be boiled (a test tube answers very well)—with a fairly bore about the edge of a small aspirating needle—this should always be employed where possible.

One of the cases I had under my care impressed me with the necessity of this precaution—explored the chest with a hypodermic syringe (the exploring syringe was being repaired) on
five different occasions, at
intervals, with as result,
I had no difficulty in obtaining
pus the first time I punctured
with an exploring needle, although
the physical signs had not markedly
altered during the interval -
The pus was very thick, as when the
chest was opened - there were
numerous masses of lymph found.

Of course, the needle is inserted where
the dulness is most absolute, & the
physical signs most marked -
or if there is evidence of pointing,
it should be introduced at this
point.

Should the signs indicate a large
effusion - Dr. S. Smith gives
the following hint, with regard
to making exploratory punctures-
"that the operation is less painful
if a spot be selected where the
thymus is thin, as in the axilla, than
if the needle be introduced in the
back, where the cutis is thick &
resistant." (ib. p. 481.)
If pus is obtained the diagnosis although nearly certain is not absolutely so for a small drop of pus may be got from a broncho-pneumonia.

The needle may have entered a cavity or small abscess in the lung.

The following case of George B. age 14 months admitted to Great Ormond Street Sept 30th 1894.

Present Illness: He had bronchitis 5 weeks ago had been vomiting since with cough restless at night & vomiting for one week.

Previous Illnesses: Bronchitis several times no specific fevers.

Family history: Father & mother well no phthisis. Two other children both died of bronchitis at 4 1/2 years 8 months.

On admission the child was pale badly nourished & he had done.
enlarged glands in neck.

Respiratory system. Right lung -
  Percussion - dullness all over.
  Auscultation - Crepitations all over upper
  part - with bronchial breathing &
  bronchophony.
  Left lung. Normal.

The heart was not displaced.

Temp. 101.4 - Pulse 128. Respiration 60.
  No albumen in urine.

The physical signs on 29. Sept. 94 -
  (about a month later) remained
  practically unaltered - except that
  the dullness at right base became
  more pronounced -
  the right chest was explored in the
  right upper joint behind the pos.
  axillary line.

No fluid was found.

On Oct 15th (about 14 days later)
  the right base was still very dull -
  there was a great sense of weight -
  ame - The chest was explored
  in the 7th interspace - behind a
  half a syringe full of pus was got.
Next day - under Morphine - about a half a syringe full of pus was again withdrawn. - the 7th rib was then resetted - but no more pus could be obtained - either with a director - or by subsequent explorations.

The pus was dark yellow - it was not offensive - the tubercle bacillus was not found.

On Oct. 25 (10 days later) eight explorations were made in different directions round - through the wound - but no pus was found.

The child gradually got worse - died on 28 Dec. 94.

A complete Post Mortem could not be made.

The right pleura was found universally adherent. A small cavity was broken into at the base of the lung just below the position of the wound - into which the needle had evidently entered - at the time of the exploration - from which the pus was obtained.
There was no pus in the pleural cavity.
The right lung was consolidated — a few caseous spots could be seen.
The left lung had scattered tubercles throughout both lobes.

Further comment is needless, it was simply a case of tuberculosis treated as an empyema — shows the difficulties of diagnosis in some cases.

I have already alluded to the fact that pus is not always procured on exploration - when it is present - as the needle may be blocked by a flake of lymph or by thick pus. Exploration may also fail by the needle passing through a thin layer of pus into the lung - or the needle may have failed to penetrate a thickened pleura - or have missed the cavity when the empyema is localized.

There is practically no danger in exploration - accidents are very rare - I have only seen one —
Subcutaneous emphysema.

I think as only one other case (Drs. Evans. Janet 2. Feb. 1888) of this accident has been recorded - the following notes are of interest - occurring in a case at Great Ormond Street.

Robert North - age 18½ months. was admitted 29. Oct. 1888 - with a history of 14 days illness, with cough & coryza.

Previous illness & no special features.

Family History - poor - Phthisis present - food had been bad.

On admission the child was manifestly very ill.


Child lay with head retracted.

The chest was poorly covered - with dulness on percussion at left apex - anterio - posterior.

Auscultation - left lung. - The breathing was bronchial at left apex. - No accompaniments of the vocal resonance was increased in this position.

Right lung - practically normal. The apex beat of the heart was forcible but not displaced.
A puncture was made with an ordinary exploring needle between the 2nd and 3rd ribs - anteriorly on the left side. No fluid was withdrawn. But almost immediately afterwards I noticed that the left side of the chest was swollen - i.e. that air was being extravasated into the subcutaneous tissue. This extended on to the abdomen and over the back where it was limited by the middle line.

The child was now turned on to the left side, i.e. the swelling seemed to diminish - the right side of the abdomen then became swollen.

The child died soon after.

Post mortem examination. Short notes -

Brain - Purulent meningitis
Body poorly nourished, surgical emphysema - all over both sides of chest & abdomen - i.e. extending into the groin - but not into the legs. A good deal of blood was extravasated into the subcutaneous tissue at the seat of puncture.
The left pleura was universally adherent - except at a point just round the seat of puncture - here there was apparently a localized pneumothorax, with some blood on the pleural surfaces. The adhesions were all of recent origin, so could be easily torn down.

The left lung was divided into three lobes - upper, middle, and lower. The upper and middle lobes were consolidated.

The puncture had entered the upper lobe, so on blowing air into the trachea, it came out at the seat of puncture.

To admit of this condition being produced, there must be adhesions between the lung and the chest wall.

Other accidents such as haemorrhage into the pleura, a pneumothorax are very rare from exploration.

In these days of careful antiseptic
precautions - there is very little chance of infecting the pleura or lung with any micro-organisms by exploration - so that this danger need hardly be mentioned.

But some - I know - of those who hold that a pleurisy which is simple does not become purulent - argue that it does not happen unless explored - thus throwing the blame on the needle.

Complications.

The presence of pus in the pleural cavity is inconsistent with good health - to say nothing of the risks the patient runs of its burrowing in various directions.

The pus may open into the abdomen and cause peritonitis or abscess in the liver.

Suppurative (or simple) pericarditis may take place by extension of the inflammation from the pleura - nearly always from the left side. It may cause amyloid degenerative
of organs - as brain & spleen - or the child may die from general tuberculosis - or other morbid condition induced by the suffuration.

Distortion of the chest is common - the spine becomes curved - the lung or lungs collapse - are bound down by fibrous adhesions which prevent re-expansion. They also become the seat of fibroid change leading to induration of their substance, a dilatation of the bronchi.

Leichtensteiner (Gerhard's Handbuch der Kinderkrankheiten) considers the escape of pus, either by operation or by spontaneous opening, as a condition sine qua non of recovery. He thinks that perforation into the bronchi is a common occurrence, often overlooked, that it explains many of the cases of apparent spontaneous resorption of the pus. He points out the fact that the opening into the lung often appears just after an aspiration, he thinks...
that the expansion of the lung opens a commencing perforation.

"While it is true that children recover after operations for empyema more rapidly, and more completely than is the rule in adults, still, in cases not operated upon the disease is more rapidly fatal in childhood (Keating of cit. p. 707).

According to Dr. Henoch—"the former belief, that deformity of the thorax occurs less frequently in children than in older people, is a mistake."

"On the contrary, we observe considerable retraction occurring on the affected side after insidious purulent effusions which finally burst externally, or from suppurating fistulae lasting for years, as well as in cases where there is formation of thick masses of fibrous tissue between the lung and the chest wall."

"In a boy of 14 who had suffered from empyema in his 6th year, I could fill up the whole right pleural cavity with my fist." (Ibid. p. 429).
But empyema may, not rarely does, kill the patient at an early stage—foe pus is a terrible irritant, it tends to cause death by collapse (the late Dr. H. G. Sutton "Lectures on Pathology", p. 240).
In case he had did not appear to be suffering much.
There was a pleural effusion, the pleura seemed to be about a quarter or a third full.
She could sit up in bed, it was not greatly disorder.
She got rapidly worse, she was dead in a few hours.
At the post-mortem she found about a pint of pus in the pleural cavity—there was no other morbid change—how urgent is a speedy evacuation of the pus.
Dr. Goodhart also describes the case of a child, a few months old, wasted to the last degree, with a moderate quantity of fluid in the left chest.
The wasting seemed to be too extreme for pleurisy alone, no nothing was done to remove the fluid.
The child died the next day. At the post-mortem revealed nothing but an empyema.
(op. cit. p. 367).
Treatment

The treatment of recent empyema in children has always given rise to much difference of opinion. During the past year there have been many interesting papers written, & discussed on the subject.

Recovery may take place without operative interference, by absorption or by opening into a bronchus—but it must be added that such a fortunate result is very uncommon, & should never be depended on.

In fact— I think I may say that all are agreed that when pus is found in the chest—it must be removed without delay—as absorption of the pus goes on very slowly, if at all—and there is no likelihood of a spontaneous cure by this method—recovery by opening into a bronchus is so rare that it should not be counted on.
If it is not speedily evacuated one or more of the disastrous results which have just been detailed are certain to follow.

As the most favourable termination that can be looked for is the drying up of the pus-leaving caseous matter in the pleural cavity - which may form later the starting point of tuberculosis. And the final prognosis is certainly bad if the case is not promptly actively treated.

"In few diseases does the ultimately perfect or partial cure depend so much on skilful and assiduous treatment - both surgical and medical" (J. Donkin - G. at p. 381).

"When the fluid has become purulent the prospect is more serious than if it remains serous, but less so in childhood than in after years; for if proper measures be adopted, a large majority of these cases recover" (J. Smith. G. at p. 481).
Aspiration

Undoubtedly a few cases of empyema in children are cured by aspiration alone— but they are comparatively few— so in the large majority of cases it can only be regarded as a temporary measure.

If one is sure that the empyema is small, & loculated, one may get a satisfactory result— but cases are rare— so this mode of treatment, even in recent cases, is often to nearly all the objections I have mentioned in detailing the necessity for early & active treatment.

"It is however (writes D.) Hancox— op. cit. p. 443— only in a very few cases of empyema that aspiration will suffice, & after repeating it once or twice, we see ourselves at last obliged to have recourse to the radical operations— that is, to opening the thorax by incision with resection of a part of a rib— I have only in three cases seen a lasting result from aspiration— even when the operation of paracentesis
is performed, or the purulent fluid is removed artificially, the case is by no means necessarily at an end. Sometimes, after withdrawal of as much fluid as can be made to pass through the aspirator, no further accumulation occurs; absorption of what remains in the pleural cavity goes on un-interruptedly, and the child is soon well.” “These cases, are, however, exceptional.” (D. Smith & J. C. 475)

"Directly a diagnosis of pus in the chest is made, arrangements should be made to evacuate it, and this in the vast majority of cases should be by free incision and drainage.

Aspiration may be tried once or twice in local empyema, especially in infants or small children, but it is only in the minority of cases that it will succeed, as the cavity usually fills up again, and separates the parts which should be kept in contact if a cure is to result.

Hence, although it occasionally
Happens that pleural abscesses do not discharge at all; or discharge through the lung or else through the skin. Where a these heal, none of these possibilities should be looked for. The cases for which it is suitable are those where the empyema is recent, of small size, contains no masses of lymph or caseous material, where the lung is not bound down by firm adhesions but is ready to expand on removal of the compressing fluid: further, it is important for the successful employment of this plan, that the pus be contained in one cavity and not localized (D'Arby & Wright G., cit. 1224).

I quote this to show that aspiration of pus should never be used — as it is — I think — impossible to say in any case that none of the above conditions are present.

Dr. Linneman gives a caution in regard to the use of the aspirator in children with empyema — it should never be too powerful — as the pleura — in many cases is much
thickened & covered with vascular
granulations, which bleed very
readily - too powerful aspiration
is apt to cause severe haemorrhage.
He has seen one child die exhausted
from bleeding after aspiration.
[Ref. cit. p. 283.]

A large proportion of the failures
of aspiration are finally treated
by incision (or resection), & a want
of success is sometimes scored
against pleurotomy which is due
rather to the delay, & consequent
loss of strength while aspiration
was being tried.
Furthermore, the final history of
the cases of recovery is important
in deciding upon the value of the
operation -
If the cheesy residue of the pus
subsequently sets up a general
tuberculosis, or a local inflammatory
process in the lung, the incomplete-
ness of the operation is directly
responsible -
Or if the lung convalescence leaves
a young & weakly child, this result
should not be counted a success
When compared with the quick and complete recovery following resection its pit.

While therefore it is conceded that aspiration will sometimes cure empyema in children, we should consider in any given case that in using this method we are subjecting our patient to a delay which may be serious; that we are giving the lung time to contract adhesions which may prevent its full expansion; so that finally the best result that we can hope to obtain is an imperfect one, which may leave the nido for a future tuberculosis.

I cannot too strongly condemn frequent aspirations, as some advocates of that system urge to 20 or 30 (in one case 122) times. "It seems a triumph of endurance on the part of the patient, of perseverance rather than of good judgement on the part of the Physician." (Keating p. 908 1862).
I am sorry to see from published cases that aspiration is practiced so often - as 11 times, 6, 5 & 4 times - in every case a further operation was needed.

Dr. Thomas Barlow has recorded good results from aspiration - yet in his words at the hospital for Sick Children - Great Ormond Street this method of treatment does not now obtain - it has not been carried out for some time.

Again - occasionally aspiration may fail to evacuate the pus owing to some defect in the working of the instrument or from the amount of solid material present - the pus rapidly reaccumulates after removal in this way -

I could quote many cases - but it would serve no useful purpose as they are so common.

I have come to the conclusion from the reasons given - that
aspiration as a curative agent in the large majority of cases is a failure even when the empyema is recent. It jeopardizes the patient's chances of ultimate recovery, I think it ought never to be practiced— even in children under two years of age—in the present state of our knowledge—except in cases in which for some good reason thorough evacuation is temporarily impossible—

In the future when the knowledge is more definite regarding the nature & characters of the fluid in empyema in children—It may be—that aspiration will cure cases in which the 

pneumococci pneumonae is only present—

< that all will agree to further operation when other micro-organisms are found such as the streptococcus pyogenes or the staphylococcus pyogenes.

There is—of course—an objection to a preliminary aspiration—indeed
it is often useful when the chest is full of pus - but it should be abandoned in favour of more radical measures within a day or two.

From the table of 91 cases I give - it will be seen that in 38 cases a preliminary aspiration was performed - it is instructive to note the amount of pus, which was obtained by resection of rib, which took place - in nearly every case - about 24 hours after. The average was 7 ounces per case, showing conclusively that aspiration always leaves behind a little - in some cases a considerable amount of purulent fluid. This toxic's statement is that absorption of pus from the pleural cavity is practically a myth.

No stronger argument can be used - as showing how ineffective aspiration is - no further proofs are needed to condemn it.
Opening the chest.

There appears to be a natural tendancy in empyemas to become cured if opened, though the falling in of the ribs may be one means—the expansion of the lungs, the ascent of the diaphragm are probably much more important factors.

The best method of treating empyema is undoubtedly that by which the most perfect drainage is obtained.

I am in favour of resecting a rib in every case in which any operation is done—this mode of treatment is the rule in all cases admitted to the Hospital for Sick Children, Great Ormond Street.

The above statement does not apply to old chronic empyemata—as all are agreed that resection of one or more ribs with removal of the periosteum is necessary in these cases.

Resection of one rib does not lead to falling in of the side of the chest—as it is reformed usually in the same
curse as the piece removed, **as a rule there is no deformity.

The discussions lately have been mostly on whether in children simple incision with drainage is sufficient in empyema or whether a rib should be resected.

I propose to give the various opinions on this point. To show that resection of rib is not so common as Dr. Fotherland seems to think—Janet 27: Jan. 94.

Dr. Ashley & Wright recommended simple incision—however they admit "that it is difficult to get a tube into the chest, & when inserted it is liable to be ripped by pressure of the ribs.

In such cases the ribs should be prised apart, & a rigid tube, such as a silver or vulcanite tracket, the tube employed" (q. v. at p. 225).

In Dr. Beattie's book incision is advocated—"which with proper precautions a free incision into a
Chest full of pus is followed by the happiest results." (P. cit. p. 718).

Dr. J. Smith is in favour of incision when aspiration has failed.

Dr. Carmichael states that resection of ribs is rarely necessary in children, as that aspiration having been tried without success, drainage should be effected without delay. (P. cit. p. 283).

Dr. Goodhart speaks strongly on this subject. If late, finding that the results of the treatment of empyema have not quite come up to their expectations, some have advocated the incision of a portion of one or more ribs, with the object of facilitating the falling in of the chest and obtaining more free drainage. If this is to be considered as the ordinary, or even frequent rule of practice for empyema, it is, in my opinion, unnecessary, and therefore meddlesome or bad surgery. "The treatment of empyema by incision, is as successful as it can
"reasonably be expected to be, if the cases are taken in good time; in cases which have been long over
looked, or which have been long discharging, whatever we may do in the majority of instances, unavail

"The opinion of surgeons is—must add, strongly, in favour of its very general adoption" (Goodhart, p. 382).

In the other hand Dr. Hcnorth does not mention incision at all—he says: "The success of the operation, especially
in children—(referring to resection) has been proved by many cases, I regard it as unnecessary for
me to give in detail my own ex-
perience— which is in favour of the operation being performed even in apparently desperate cases."

"I cannot impress upon you too strongly the importance of performing the operation without
delay, as soon as the purulent
nature of the effusion has been established" (Op. cit. p. 433).
"I have ample evidence (writes Dr. Dorhui) from the comparative results of my earlier and later cases, that incision of the pleura without delay is completely successful in many instances; I am further convinced that the modern plan of sub-periosteal causation of a portion of one or more ribs is almost always advisable, as conducing at once to better drainage in all cases (whether the lung can re-expand itself or not), so to the earlier closing of the pleural fistula by aiding the chest-walls to fall in when the lung is permanently crippled." (G. H. 1: 384).

The late Dr. Burgess said "I have lived through several stages of belief in this matter, but at one time held that, provided a free vent for pus could be secured and maintained, the removal of rib was unnecessary. But I have learnt better. In almost all cases, as I now believe, resection is needed." I can refer to my own practice at the Children's Hospital (Great Ormond
(Janet 12. May 94.)

Mr. J. P. Wightman thinks "Incision & drainage are in the majority of cases quite sufficient" so that the major operation, resection of gut, is not often called for (Janet 5. May 94).

Mr. A. J. Morrison in his article on this subject (Janet 29. Oct 94) says under the conclusions "that incision & drainage may be trusted to cure all cases genreal empyema."

At the Medical Society of London - there was a paper read by Dr. Cantley on 28. Jan 95. - it is not...
yet published — but he advocated enucleation and drainage in preference to resection — although he admitted that from his cases the mortality was almost the same, & the duration of the after treatment differed in the matter of one or two weeks in favour of resection.

Five out of six cases under two years of age treated by resection died.

An analysis of the fatal cases showed that in a large proportion, death was not due to anything connected with the operation or wound.

He laid stress on the fact that the operation of resection was more severe — so that this was an advantage especially in private practice.

At the West London Medical-Chirurgical Society — 5 April 95, Dr. J. A. Coutts read a paper on this subject.

Statistics were given of 27 cases treated by simple incision, & of 61 cases treated by rect resection.

Notwithstanding the unfavourable results of the former as compared with the latter — Dr. Coutts thought it should be tried more especially
in the debilitated cases.

He gave statistics of 113 cases of empyema in children under the age of two years, with 27 deaths. Emphyema was in itself so fatal at an early age that the responsibility for the high mortality did not rest on one operation or another.

Although here again the results were favourable to the method of rib resection, Mr. Coutts was, on the whole, inclined to the opinion that simple incision was preferable in these infants.

In the discussion which followed Mr. Bidwell had known cases of the rib to follow resection for emphyema in children, and therefore was inclined to recommend simple incision in every case where the pus was not solid. He thought, too, the patient's stay in hospital was shorter after simple incision than after resection of rib.

Mr. Arbuthnot Lane was the first to suggest that the primary treat
ment of recent emphysema in children should be the removal of a portion of a rib."

"Pointing out that the usual operation (at that time) of incising the intercostal space fails frequently."

[Vol. XXVI. "Guy's Hospital Reports."

Mr. Bernard Pitts in an address on the Surgery of the Air Passages of Throat in Children—delivered at the Royal College of Surgeons of England—said "And when pus is found in the pleural cavity I would strongly favour under most circumstances its free evacuation without further delay."

"In children the removal of a portion of a rib has no disadvantage & many advantages, for without it, satisfactory drainage by a soft tube is impossible in young children, & particularly in chronic cases where the ribs are crowded together."

"A silver tube is painful & apt to produce caries of the ribs by pressure."

"The great advantage to be gained
By removing a piece of rib so that the pleural cavity can be thoroughly explored with the finger-adhesions imprisoning remote collections of pus can be broken down a solid mass of lymph can be removed -.

"There is very little increase in the shock of the operation, the dressings, management of the tube are attended with much less discomfort to the child. Experience has proved that there is no increased risk of pyaemia or a very little danger of necrosis of the cut ends of the ribs".

"After a considerable experience of rib resection in empyema I have never had reason to regret doing it, in a large proportion of cases I am sure that the cure has been hastened by the immediate removal of coagulated exudate." (Lancet. 14: Dec. 93).

As I have already said I am in favour of rib resection. The following are a few notes on
The operation - chiefly gathered at Great Ormond Street.

When pus is found by the explor-ing syringe - preliminary aspiration is done in some cases, & the child is prepared for rib resection which follows usually in about 24 hours.

The operation is quite simple, so the dangers have been much exaggerated.

Chloroform is undoubtedly by far the best anaesthetic - children always take it well - one does not get the troublesome coughing or secretion of mucus - which one does with ether - even when the lungs are healthy in a child - need not detail the other disadvantages of ether - Bronchitis etc.

The exploring needle is used again when the patient is under - to ascertain that pus is present over the spot where it is proposed to resect - this in most cases is the 8th rib - just below the angle of
the scapula.

I do not agree that the opening should be made further forward as suggested by Mr. Godlee - it certainly makes the operation a little easier - but I am sure that it is best to treat these cases on the lines of an ordinary abscess - i.e. to make the drainage dependent.

The child can be turned partly on its side - when all is ready - but one must keep a more than usual careful watch on the breathing - I have never had or seen any difficulty from this cause, so it should not be necessary to keep the child in this position more than 5 or 6 minutes - if the breathing gives trouble the child can be brought to the edge of the table.

If the bit is to be resected at the back or side - i.e. the arm is raised - one must not make the incision over the centre of the pit, if it is proposed to operate on - or the opening in the chin, or the hole
in the rib will not correspond. When the empyema is local the resection must of course be made over the plane where the physical signs are most marked & the lowest convenient spot for drainage chosen - for reasons already mentioned.

When the rib is reached - the periosteum is divided first by two vertical incisions about one back & a half apart - i by a horizontal in the centre of the rib joining the two already made.

Reflecting the periosteum presents no difficulties - but in young children with recent empyema it is much thinner than in adults so care must be exercised - not to open the chest before one is ready so not to reflect more periosteum than bone is to be removed.

Professor Chene laid great stress on this point - the need of doing the operation "dry" - a rightly so for if the pleural cavity is opened prematurely the difficulties of the operation are very much increased.
Care must also be taken not - in recent cases - to damage or remove the periosteum - or the rib will not be reformed perfectly - as it usually is in about six weeks time -

The rib is cut out easily with straight or angular bone forceps. I prefer "osteoder's rib resector" when it is obtainable - as it is quicker & easier to use, & there is less chance of opening the pleura or splintering the rib.

Haemorrhage is quite exceptional, if present it is more easily controlled than in incision as one can see what one is doing -

It only remains to incise the pleura with a knife - I place a finger in to regulate the flow of fluid necessary, break down adhesions, feel size of the cavity - search out & remove all masses of fibrin etc.

I have little experience of washing out the chest - I have seldom seen any need for it - as if the empyema is putrid & foul when opened
- it usually quickly becomes sweet if the drainage be free.
- It is very generally condemned - as it adds to the danger of the formation - as sudden death may follow.

A large soft drainage tube is placed in the wound - it should not project into the chest. The tube is transversely threaded through an opening made in another - and the two are drawn together forming a T. (see drawing)

This plan is to be preferred to safety pins or wire - which soon become corroded - are not so comfortable - are not so easily cleaned - are not so effective - in preventing the serious accident of the tube slipping into the chest.

The tube can be replaced by a smaller one in a few days - should be omitted as soon as possible.
In the following table will be found a synopsis of 91 cases of empyema treated by resection of rib or ribs—62 males—29 females. They are taken from the clinical records at the Great Ormond Street Hospital for Sick Children—and I have followed many of the cases. They are not selected in any way—as every case in which resection was performed—occurring under two of the Physicians—has been included. They comprise about two thirds of all cases treated in this hospital from 1889 to 1894 (five years).

The table explains itself—I will only add that—M = Male
F = Female—The age is stated in years except where months are mentioned.

Duration is of course doubtful in some cases—under ‘Aspiration’ the amount of pus removed by this method is given.
## Table of ninety one cases of Empyema

<table>
<thead>
<tr>
<th>No.</th>
<th>Side</th>
<th>Duration</th>
<th>Aspiration</th>
<th>Atelectasis</th>
<th>Amount</th>
<th>Take out</th>
<th>Integument</th>
<th>Result</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Left</td>
<td>6 moths</td>
<td></td>
<td></td>
<td>8 oz</td>
<td>10 oz</td>
<td>20 days</td>
<td>34 days</td>
<td>Cured</td>
</tr>
<tr>
<td>2</td>
<td>Left</td>
<td>8 oz</td>
<td>re-stated</td>
<td>2 oz</td>
<td>38 &quot;</td>
<td>45 &quot;</td>
<td>Cured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Left</td>
<td>3 oz</td>
<td>8 oz</td>
<td>4 oz</td>
<td>6 &quot;</td>
<td>35 &quot;</td>
<td>Cured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Left</td>
<td>4 ½ oz</td>
<td>8 oz</td>
<td>18 oz</td>
<td>35 &quot;</td>
<td>50 &quot;</td>
<td>Cured</td>
<td>6th 29th</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Right</td>
<td>24 days</td>
<td>8 oz</td>
<td>3½ oz</td>
<td>25 &quot;</td>
<td>60 days</td>
<td>28 days after the 8th</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Right</td>
<td>6 oz</td>
<td>re-stated</td>
<td>2 oz</td>
<td>33 &quot;</td>
<td>49 days</td>
<td>Cured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Right</td>
<td>4 ½ oz</td>
<td>8 oz</td>
<td>25 oz</td>
<td>35 &quot;</td>
<td>63 days</td>
<td>Cured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Left</td>
<td>3 oz</td>
<td>8 oz</td>
<td>3 oz</td>
<td>22 &quot;</td>
<td>60 &quot;</td>
<td>Cured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Left</td>
<td>3 oz</td>
<td>8 oz</td>
<td>6 oz</td>
<td>13 &quot;</td>
<td>35 &quot;</td>
<td>Cured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Left</td>
<td>3 oz</td>
<td>7 oz</td>
<td>7 oz</td>
<td>28 &quot;</td>
<td>Cured</td>
<td>9th +10th</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Left</td>
<td>2 months</td>
<td>8 oz</td>
<td>7 oz</td>
<td>42 &quot;</td>
<td>63 &quot;</td>
<td>Cured</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Remarks: Resected 35 days after 8th.*
<table>
<thead>
<tr>
<th>No.</th>
<th>Date</th>
<th>Side</th>
<th>Duration</th>
<th>Aspiration</th>
<th>Unit Weight</th>
<th>Amount</th>
<th>Days</th>
<th>Result</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17/12</td>
<td>Left</td>
<td>7</td>
<td>8</td>
<td>6.02</td>
<td>--</td>
<td>13</td>
<td>Death</td>
<td>Pyo-pericarditis</td>
</tr>
<tr>
<td>2</td>
<td>5/12</td>
<td>Left</td>
<td>7</td>
<td>6.27</td>
<td>6.02</td>
<td>56</td>
<td>75</td>
<td>Cured</td>
<td>Pointing, Ascension, 6 more ribs 35 days later</td>
</tr>
<tr>
<td>3</td>
<td>2 1/12</td>
<td>Right</td>
<td>1 1/2 th</td>
<td>Not stated</td>
<td>1 1/2 oz.</td>
<td>--</td>
<td>35</td>
<td>Death</td>
<td>30 days Death, Tbculum</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Left</td>
<td>2 1/2th</td>
<td>4.02</td>
<td>3.02</td>
<td>10</td>
<td>30</td>
<td>Death</td>
<td>Tbculum</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>Left</td>
<td>3 days</td>
<td>Not stated</td>
<td>10.02</td>
<td>--</td>
<td>17</td>
<td>Cured</td>
<td>Pointing</td>
</tr>
<tr>
<td>6</td>
<td>3 3/12</td>
<td>Right</td>
<td>7 who</td>
<td>1.02</td>
<td>8 1/2</td>
<td>2.02</td>
<td>5</td>
<td>12 days Cured.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1 1/2</td>
<td>Left</td>
<td>6.02</td>
<td>Not stated</td>
<td>6.02</td>
<td>--</td>
<td>49</td>
<td>Cured</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>2 1/2</td>
<td>Left</td>
<td>1.02</td>
<td>8</td>
<td>5.02</td>
<td>35</td>
<td>77</td>
<td>&quot; &quot;</td>
<td>Cured</td>
</tr>
<tr>
<td>9</td>
<td>2 1/2</td>
<td>Left</td>
<td>7 who</td>
<td>13.02</td>
<td>9.02</td>
<td>11.</td>
<td>35</td>
<td>&quot; &quot;</td>
<td>Cured</td>
</tr>
<tr>
<td>10</td>
<td>6 1/2</td>
<td>Right</td>
<td>8 who</td>
<td>8</td>
<td>5.02</td>
<td>8</td>
<td>32</td>
<td>&quot; &quot;</td>
<td>Cured</td>
</tr>
<tr>
<td>11</td>
<td>9 1/4</td>
<td>Right</td>
<td>11 days</td>
<td>20.02</td>
<td>10.02</td>
<td>7</td>
<td>27</td>
<td>&quot; &quot;</td>
<td>Cured</td>
</tr>
<tr>
<td>12</td>
<td>1 1/2</td>
<td>Right</td>
<td>3 months</td>
<td>6.02</td>
<td>8</td>
<td>3.02</td>
<td>7</td>
<td>63</td>
<td>Cured</td>
</tr>
<tr>
<td>13</td>
<td>14/12</td>
<td>Right</td>
<td>4 months</td>
<td>6.02</td>
<td>8</td>
<td>2.02</td>
<td>3 days</td>
<td>42</td>
<td>Cured</td>
</tr>
<tr>
<td>Sex</td>
<td>Side</td>
<td>Duration</td>
<td>Aspiration</td>
<td>Air sucked</td>
<td>Amount of Fluid Examined</td>
<td>Tube Use</td>
<td>Tube Out</td>
<td>In Hospital</td>
<td>Result</td>
</tr>
<tr>
<td>-----</td>
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</tr>
<tr>
<td>M. 2½</td>
<td>Right</td>
<td>1 mth.</td>
<td>7th</td>
<td>14 oz.</td>
<td>6 days</td>
<td>28 days</td>
<td>Cured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M. 8½</td>
<td>Right</td>
<td>3 yrs.</td>
<td>2 ribs</td>
<td>Not stated</td>
<td>28 vs. 43</td>
<td>Cured</td>
<td>Pneumonia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M. 7½</td>
<td>Left</td>
<td>5 days</td>
<td>Not stated</td>
<td>10 oz.</td>
<td>--</td>
<td>--</td>
<td>Death</td>
<td>Pyo-pericarditis</td>
<td></td>
</tr>
<tr>
<td>M. 4</td>
<td>Right</td>
<td>7 days</td>
<td>2 oz.</td>
<td>14 oz.</td>
<td>16 days</td>
<td>42 days</td>
<td>Cured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. 2½</td>
<td>Left</td>
<td>1 mth.</td>
<td>5 oz.</td>
<td>9 oz.</td>
<td>7 days</td>
<td>47 days</td>
<td>Cured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M. 5½</td>
<td>Left</td>
<td>7 days</td>
<td>6 oz.</td>
<td>10 oz.</td>
<td>7 days</td>
<td>30 days</td>
<td>Cured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M. 6</td>
<td>Right</td>
<td>4 days</td>
<td>8 oz.</td>
<td>4 oz.</td>
<td>7 days</td>
<td>30 days</td>
<td>Cured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M. 1½</td>
<td>Left</td>
<td>1 mth.</td>
<td>10 oz.</td>
<td>Not stated</td>
<td>10 oz.</td>
<td>--</td>
<td>13 days</td>
<td>Death</td>
<td>Pericarditis</td>
</tr>
<tr>
<td>M. 5</td>
<td>Left</td>
<td>1 mth.</td>
<td>1 oz.</td>
<td>14 oz.</td>
<td>--</td>
<td>--</td>
<td>42 days</td>
<td>Cured</td>
<td></td>
</tr>
<tr>
<td>F. 5½</td>
<td>Left</td>
<td>6 days</td>
<td>8 oz.</td>
<td>3½ oz.</td>
<td>38 days</td>
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**Other Information:**
- 2 1/2 Light 3 1/2 oz placed in 4 oz bottle with 8 oz added.
- 3 1/2 Light 8 oz added to 4 oz bottle.
- 5 1/2 Light 5 1/2 oz placed in 8 oz bottle.
- 2 1/2 Light 2 1/2 oz placed in 2 oz bottle.
- 2 1/2 Light 2 1/2 oz placed in 2 oz bottle.
- 2 1/2 Light 2 1/2 oz placed in 2 oz bottle.
- 3 1/2 Light 3 1/2 oz placed in 2 oz bottle.
- 3 1/2 Light 3 1/2 oz placed in 2 oz bottle.
- 3 1/2 Light 3 1/2 oz placed in 2 oz bottle.
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The table above contains information about patients and their medical conditions, including the side affected, duration of treatment, amount of fluid aspirated, and duration of illness before and after treatment. The results indicate that most patients were cured, with a few deaths recorded.
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<td>2</td>
<td>10.02</td>
<td>8</td>
<td>8.02</td>
<td>8</td>
<td>10 days</td>
<td>24 days</td>
<td>Cured</td>
</tr>
<tr>
<td>M</td>
<td>Right 3  whs</td>
<td>-</td>
<td>-</td>
<td>8</td>
<td>5.02</td>
<td>8</td>
<td>18 days</td>
<td>24 days</td>
<td>Cured</td>
</tr>
<tr>
<td>M</td>
<td>Left 1 mth</td>
<td>-</td>
<td>-</td>
<td>8</td>
<td>17.02</td>
<td>7</td>
<td>7 days</td>
<td>91 days</td>
<td>Death</td>
</tr>
</tbody>
</table>

- Empyema
- Recked - Paracentic meningitis with vegetations on frontal value

| M     | Left 7 who | 9.02 | 8 | 2.02 | 17.02 | 31 days | Cured     |

- M 15 double 6 whs
- A. 8th 18 Jan
- 4.02 8 days 87 days Cured

| M     | Right 12 | 8.25 | 4 | 2.12 | 22 days | Cured     |

| M     | Left 6 oz | 2.21.02 | 18 days | 3.6 | Death | Left empyema found 22m |

| M     | Double 2 who | 2.02 | 9 | Left 1 oz | 6.21 | Death | Left empyema found 22m |

\*on right side - serum 3 days before death.
Table showing the number of cases & the result for each year of age.

**Unilateral Empyema.**

<table>
<thead>
<tr>
<th>Age</th>
<th>Cured</th>
<th>Died</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 12 months</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>&quot; 2 years</td>
<td>9</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>&quot; 3</td>
<td>20</td>
<td>3</td>
<td>23</td>
</tr>
<tr>
<td>&quot; 4</td>
<td>13</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>&quot; 5</td>
<td>9</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td>&quot; 6</td>
<td>11</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>&quot; 7</td>
<td>6</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>&quot; 8</td>
<td>2</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>&quot; 9</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>&quot; 10</td>
<td>4</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>&quot; 11</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>&quot; 12</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>77</td>
<td>10</td>
<td>87</td>
</tr>
</tbody>
</table>

**Double Empyema.**

<table>
<thead>
<tr>
<th>Age</th>
<th>Cured</th>
<th>Died</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 2 years</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>&quot; 3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>&quot; 10</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>
Table III: Twelve Fatal Cases of Empyema out of ninety one.

<table>
<thead>
<tr>
<th>Age</th>
<th>Complaint</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2</td>
<td>Left Empyema</td>
<td>Pyopericarditis</td>
</tr>
<tr>
<td>2 2/12</td>
<td>Right Empyema</td>
<td>Empyema secondary to left Empyema</td>
</tr>
<tr>
<td></td>
<td></td>
<td>abscess in lung</td>
</tr>
<tr>
<td>2 4/12</td>
<td>Left Empyema</td>
<td>Pyopericarditis</td>
</tr>
<tr>
<td>1 1/2</td>
<td>Right Empyema</td>
<td>Pericarditis</td>
</tr>
<tr>
<td>1 6/12</td>
<td>Left Empyema</td>
<td>Died of diphtheria - Empyema healed</td>
</tr>
<tr>
<td>2 3/12</td>
<td>Right Empyema</td>
<td>Empyema due to rupture of osseous gland-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>death day following operation</td>
</tr>
<tr>
<td>5</td>
<td>Right Empyema</td>
<td>Died of tuberculosis 84 days after closure of Empyema</td>
</tr>
<tr>
<td>3 1/2</td>
<td>Left Empyema</td>
<td>Endocarditis found with large vegetations on tricuspid valve. Died day after admission</td>
</tr>
<tr>
<td>1 1/2</td>
<td>Right Empyema</td>
<td>Empyema healed - Paracent meningitis &amp;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vegetations on aortic valve.</td>
</tr>
<tr>
<td>2 6/12</td>
<td>Double Empyema</td>
<td>Left Empyema found at Post Mortem</td>
</tr>
</tbody>
</table>
|       | The left side opened, the right side was aspirated three days before death - serum got at the necropsy pus was found on the right side.
It will be seen from Table III that three of the deaths occurred from causes quite independent of the empyema; therefore deducting these from the whole number, there remain 88 cases, out of which 9 died giving a mortality of 10 per cent in all cases.

Taking the cases under three years of age, 32 were cured 29 died — but of these 9, it will be seen on reference to Table III — that one died from diphtheria.

Thus, out of 41 cases under three years of age, 32 recovered 9 died giving a mortality of 19 per cent.

Again — taking the 87 unilateral cases & deducting the 3 deaths from extraneous causes — the mortality was under 8 per cent.

Comparing these figures with those given by Mr. J. P. Wightman (Jancet 5: May 94) obtained from the Infirmary for Children — Liverpool — where irrigation is practised — I think they show a definite advantage is
gained by resection - as his results with excision were 20 per cent in all cases, 250 per cent in cases under three - compared with 10 per cent in all cases, 2 19 per cent under three obtained with resection.
are the following-

In children the spaces between the ribs are so small that one cannot get one's finger properly in— in many cases it can't be got in at all—to explore the cavity, break down adhesions, s Burr out masses etc.

More efficient drainage—Petarco, in the report of his cases attributes the closing of the cavity to the free drainage rather than to the falling in of the ribs.

Again in children the spaces between the ribs are small, so become much more so, owing to the falling in of the chest & approximation of the ribs after the cavity is opened—on the side may be retracted at the time of the operation so that a soft tube has its calibre narrowed or obliterated, if a firm one is used, its sectional area is necessarily small while to become obstructed by the masses of tough, caseous typhoid, which are
frequently too large to come away through an intercostal incision. This material takes some time to break up, so by its presence serves as a source of irritation, preventing the approximation of the surfaces of the abscess cavity.

At the same time, to prevent the tube being forced out by the movements of the adjoining ribs, its inner aperture cannot be rendered flush with the inner wall of the chest, but must be made to project some way into the space, so much pus must remain which cannot escape.

The tube is frequently obliquely placed with the inner end projecting upwards, owing to the shape of the rib surfaces.

A hard tube also causes much pain by its pressure, sometimes necessitating its removal. It not infrequently causes oedema of the adjoining ribs; this is often a troublesome complication, remaining after the abscess cavity has closed. These are a few of the disadvantages of incision.
The child is a shorter time in hospital - the mortality is smaller, so the results are much better with resection.

It is difficult to say how many cases which are treated by incision have finally to be resected - as the advocates of incision carefully refrain from giving figures on this point.

Perhaps it is their experience in these cases - which leads them to say that incision "will cure all cases of curable empyema" - so I conclude after trying incision for a year - it is quite possible that resection may fail.

I have seen a good many cases in which incision failed - as in which a further operation was needed.

The following case - at present in the wards at Great Ormond Street - is an example:

Violet T. admitted 16. March, with a history of being taken ill seven days before - feverish, short
of breath:
In admission - age 2 years, 2 months
Child pale, wasted, clubbed
Finger ends & ends of toes distinctly clubbed.

Previous History - She had Broncho-
Pneumonia in October 1893 (17
months ago) - complicated with
Empyema. After being injured,
there was some discharge from the
wound for 12 months afterwards
is it has broken out once or twice
since.

Examination of
Chest: There is a discharging sinus
on the left side in the 7th intercostal
space outside nipple line, leading in for three inches.
The left side is flattened, there is
improvement on percussion all
over the left side in front, in
the left axilla this is more marked.
The note is resonant behind left lung.

Aspiration: Crepitations all over
left lung - front & back, with
feeble air entry especially in
left axilla - Right lung - normal.
Liver & spleen both enlarged
(many cyst degeneration).

Here we have bronchitis attacking
at a damaged lung.
The wound is still discharging
(15: Apr. 95) but the bronchitis
has nearly disappeared - the
temperature is irregular, & the
child perspires profusely.
I have never seen such a case
after resection.

I have very rarely seen cases of
the rib follow resection, never
pyaemia, & the increased
severity of the operation has been
much exaggerated -
Is it more severe than forcing the
ribs apart ??

But it is said "that the large aper-
ture that is made by the
removal of the rib quickly closes
up & we are no better off than
before" (Goodhart: Q. et. p. 382.

This I can prove is incorrect - as I
have a piece of rib removed from
a boy - aged one year & nine months
whose rib was resected on 18: Oct: 94
who died about 6 months after-
wards from diphteria.
The tube was kept in some time - so it will be seen by the drawing of the specimen that complete ossification has taken place round the soft tube - forming a hole through the rib. This case must not be considered an exception - as I have never had any trouble from the bone reforming and interfering with the drainage - as long as the rubber tube was kept in.

**Chronic Empyema.**

I have only seen one case which burst spontaneously - it died 20 between the 2nd & 4th ribs - in the nipple line on the right side. The boy had been ill a year, he was much wasted when he was carried into the Gloucester Infirmary. A rib was resected at angle of the scapula - he left much improved in every way - his side was retracted, but both wounds healed soundly with one operation.
All are agreed that the chronic cases should be treated by resection of several ribs—without removal of the periosteum—first recommended by Estlander—if simple evacuation by incision or resection fails.

I give 10 cases in Table I where a further operation was needed—they were of course tedious, as the average stay was 7-14 weeks. All however were finally discharged cured—although retraction of the affected side was more or less marked in all.

One boy age 1½ years—wo ventral incision + 2 operations—s had pieces of the 3, 4, 5, 6, 7, 8, 9 to 11 ribs on the right side removed—a who remained in hospital for 19½ days—Examined 9 months after his discharge. The boy was fairly well nourished—but pale. The right lung was dull all over with very gaseous air entry. The left lung doing all the work. But the wound was quite sound, a there had been no discharge from it since the left hospital. The spine was curved—a the chest retracted on the right side. He complained of no pain
The cases of double empyema are not numerous enough to warrant any conclusions— I need only say from my experience— there is reason for an interval of more than one day between opening the two pleuræ.

In the final treatment of all cases— of course— fresh air— with the use of every means to expand the chest— lungs— should be insisted on.

The final history of the cases of recovery is important in deciding upon the value of the operation.

I can find no results after incision but Dr. Dohrn gives excellent results obtained in empyema after resection— He examined 24 cases sometime after discharge from hospital—

The results however— correspond very closely with the after state of the children examined at the Great Ormond Street Hospital— which are as follows.

The number of cases examined was 23— the average time of the examination— was two years and seven months after leaving hospital.
The rib had reformed perfectly in every case as far as could be seen, but there was no fusion in some cases with the rib above or below the one resected.

In 22 cases the spine was straight. In one there was slight lateral curvature.

The breath sounds were feeble in seven of the cases - but in four of these this condition only obtained below the scar.

The affected side was slightly retracted in four out of the twenty cases of unilateral empyema.

Three of the patients had had double empyema treated by resection on both sides - in two of these the result was very good - in the other one there was some retraction on both sides with feeble breath sounds at both bases.

Further details will be found in the accompanying Table II.
Table IV

After results in twenty-three cases of empyema treated by resection of pleura.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age</th>
<th>Side</th>
<th>Out of Hospital</th>
<th>Air Pleural</th>
<th>State Pleura</th>
<th>Breath Sounds</th>
<th>Retention of Pleura</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>74</td>
<td>Left</td>
<td>2 years</td>
<td>Perfectly</td>
<td>Straight</td>
<td>Good</td>
<td>Int.</td>
</tr>
<tr>
<td>Male</td>
<td>5½ years</td>
<td>Right</td>
<td>4½ years</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Female</td>
<td>9 years</td>
<td>Left</td>
<td>4 years</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Female</td>
<td>10 years</td>
<td>Right</td>
<td>1½ years</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>&quot;</td>
<td>3</td>
<td>Right</td>
<td>2</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Male</td>
<td>11</td>
<td>Left</td>
<td>4</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Female</td>
<td>4</td>
<td>&quot;</td>
<td>1½</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>&quot;</td>
<td>3</td>
<td>&quot;</td>
<td>1³⁄₄</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>&quot;</td>
<td>7</td>
<td>Right</td>
<td>3½</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
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<tr>
<td>Male</td>
<td>10½</td>
<td>&quot;</td>
<td>3</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>&quot;</td>
<td>4½</td>
<td>Left</td>
<td>1½</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Female</td>
<td>5</td>
<td>Right</td>
<td>2</td>
<td>&quot;</td>
<td>&quot;</td>
<td>Normal</td>
<td>&quot;</td>
</tr>
<tr>
<td>Male</td>
<td>4½</td>
<td>Left</td>
<td>3</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Male</td>
<td>6</td>
<td>Left</td>
<td>4</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Male</td>
<td>8</td>
<td>Right</td>
<td>2</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Female</td>
<td>4</td>
<td>Left</td>
<td>1½</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Male</td>
<td>10</td>
<td>Left</td>
<td>2</td>
<td>&quot;</td>
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</tr>
<tr>
<td>Male</td>
<td>5½</td>
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<td>2</td>
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<tr>
<td>&quot;</td>
<td>4</td>
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<td>1½</td>
<td>&quot;</td>
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<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>&quot;</td>
<td>9</td>
<td>Right</td>
<td>4</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>&quot;</td>
<td>11</td>
<td>Double</td>
<td>6</td>
<td>&quot;</td>
<td>&quot;</td>
<td>Good</td>
<td>&quot;</td>
</tr>
<tr>
<td>&quot;</td>
<td>12</td>
<td>Double</td>
<td>1½</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Female</td>
<td>6</td>
<td>Double</td>
<td>1½</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
</tbody>
</table>
The results, I have given of the success of resection of rib in the treatment of empyema, are as good as can be hoped for.

And I trust soon to see the tide turn in favour of resection— not only in cases in which aspiration & incision have failed— but as the primary treatment in every case of recent empyema. And to find in the future that statements such as "resection of rib is meddlesome or bad surgery" have been relegated to the past.

I have the honour to be

Sir & Gentlemen,

your obedient servant,

George Porter.

The Hospital for Sick Children,

Great Ormond Street,

London W.C.

April 1893.