A Thesis

Empyema and Allied Thoracic Effusions
considered Historically, Clinically, Experimentally
and Practically.

by

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The more refined clinical methods which were made known by
the discoveries of Hippocrates and Laurusse came into use. But
the treatment of this ailment had gone through many and various
changes, which have depended in part upon modifications in
curative skill and appliances, and in part apparently upon the
results which were attained by individual practitioners.

The first of these phases probably took place among the Greeks
themselves during the sixth and seventh centuries, when their society
seems to have become unpopular; Akey to this is found in
by Pausanias in quoting, who says: "Others, as Laurusse says, having passed
a hundred centuries, having carried the burning torch to the face,
some have clung to operate upon them by making a transverse incision,
or else a little obliquely in the skin between the 6th and 7th ribs, then
perforating with a knife the membrane lining the ribs, and then
evacuating the pleur; but they and those who burnt with iron
to a considerable depth the latter occasion immediate death, the
vital spirit being evacuated with the pleur, or occasion inaneable
picture." (14) Moro, who is believed to have lived about the
sixth century made no mention of this operation, and both of
the above ancient authorities preferred to produce superficial
ecchymoses by means of the actual cautery, presumably in the
hopes of causing absorption by this counterirritation. This
practice also continued itself among the Arabsians, as noted
in a commentary on the above translation by S. Adams,
who mentions that Sahl al-Akbar and Khazar were accustomed
to recommend it, although the latter seems also to have
practiced punctures by means of a small affeene,
so as to allow a slow evacuation of the pleur. For this reason—
The anterior thirds of the ribs on the right side having been carefully removed without injuring the pleura, the fluid could be seen occupying the anterior, lateral and posterior lateral part of the chest. On incising the pleura the lower lobe of the lung was found to have retracted backwards towards the root of the lung. The upper lobe was projecting anteriorly over the bag of fluid and it contained plenty of air.

The ribs were having been placed as far as possible in situ again, the left side of the chest was opened. The heart was seen to be pushed over to the left by the fluid, the right ventricle lying in opposition with the bag and its cavity evidently approached upon by this pressure. There was no apparent alteration in the heart's axis; in travelling from right to left it had followed the curve of the ribs. Rather more right ventricle than normal seemed to be visible.

The upper surface of the diaphragm was next examined and the previous observations confirmed. The left cupola was highly arched, the right one was flattened to present a central depression.

Tracing taken from the plaster cast.
I

A medium sized dog having been placed under the influence of chloroform as in the former experiment, an incision 3/4 inch long was made over the 6th left inter-costal space - laterally; and an india rubber bag prepared in the way previously described, was slipped into the pleural cavity (which is easily done without the entrance of air) the skin incision was firmly tied round the joint side.

The chest was examined, and the percussion note found to be resonant throughout. The breath sounds vesicular and the heart was beating on the left side.

II

A pneumograph having been fixed round the chest, and connected with a recording lever, tepid water was slowly injected into the bag. The tracing shows the effect of the injection upon the frequency and depth of the respiratory movements.

III

When 50 cc had been injected, the percussion note at the base was dull and the breath sound (vesicular) expelled. The respiratory movements were distinctly impaired on the left as compared with those on the right side.

IV

The injection was continued until 295 cc had been injected and as the fluid increased, the frequency of the respiratory movements increased. The dyspnoea becoming more and more marked. The left side presented little respiratory movement after about 150 cc had been injected and when the whole amount had entered the chest its movements were practically nil.
On the other hand, the movements of the right chest became more
and more exaggerated the extra ordinary muscles of respiration
including the diaphragm and intercostals, all acting vigorously.

V

At this time the percussion note was dull all over the left side, but
resonant of the upper third of the chest.

The breath sounds were almost inaudible over the dull area, but
resonant in type (the absence of any tendency to a bronchial cough
would be explained by the absence of the larynx). In the upper
third of the chest, the sounds were harsh, resonant, and anteriorly.

On the right side, the percussion note was
resonant. The breath sounds harsh and resonant throughout.

The heart could be heard beating to the right of the sternum.

VI

An incision large enough to admit the finger was made
in the epigastrium and the diaphragm explored from below.

On the left side the muscle presented a central slight
concavity and there was a slight concavity near the left
region of attachment as noted in former experiments.

During inspiration the central concavity became flattened,
the contractions of the muscle straightened it out. The
impression was gained that the diaphragm on this side
could not act as an inspiratory muscle and that its contraction
would cause further enるために in the thoracic cavity.

On the right side the muscle was highly arched during inspiration
and its contractions were vigorous. The heart could be
felt beating at a point between the centre of the right apex
and the right hepatic cartilage, rather nearer the latter.
The right side of the chest was then perfectly opened by cutting through several of the ribs and cartilages with a small pair of bone forceps. A portion of the heart was then exposed beneath its inner ventricular sheet. The organ was lying well to the right of the sternum, but its outer two-thirds and its apex was covered by the anterior thin margin of the right lung. It is therefore a mistake to suppose that the entire right ventricle impinges on the chest wall during contraction in these cases. (Vid Sketch).

The heart continued to beat for a few minutes after opening the chest and during contraction it could be seen to lift the portion of lung overlapping it.

On opening the pericardium it was at once seen that there was no appreciable atrophy in the cardinal axis. Its ligaments were some above downwards and downwards.

The aorta was situated near to the carina form cartilage. The entire anterior aspect of the heart consisted of right ventricle. The inter ventricular groove could not be seen without lifting the inner presenting border of the organ.

The right ventricle was greatly distended (in part the result of the stoppage of perfusion).
The left side of the chest was now opened. The lower lobe of the left lung was compressed and had retracted towards the root of the lung. The upper third of the upper lobe was well filled with air and projected forward over the bag containing the water. Its inflation would account for the resonant note over the upper part of the chest, the lower posterior portion of this lobe—was partially collapsed.

Having placed the respirator as far as possible in situ on the left side, more fluid was injected into the India rubber bag and the heart watched meanwhile. It could be seen to travel to the right without any pendular action when the ribs and lung were kept in apposition with it.
Treatment

Empyema, although a disease which comes under the care of the physician in the first instance, eventually, whenever the diagnosis is established requires the aid of the surgeon for its treatment, there being only one efficient way of dealing with a chest containing pus, viz. to empty it through an external opening. It is a complaint, however which so often has its origin in other excavating as well as infecting diseases which are essentially in the physician's province, and its recognition, as well as the complications which are oft to arise during its treatment are so evidently medical in their nature, that it may fairly be claimed as one of those ailments which the physician should watch in conjunction with a surgeon, and furthermore it is just a question whether, by the careful selection and treatment of some of the cases of empyema which are known to be primary ones and at length tend to become purulent, empyema may not be prevented.

If there is one thing that belies the popular belief which consists in the carefree curing of pneumonia and some of the other diseases oft to give rise to purulent effusions if neglected, there are a certain number of cases cases which can be prevented from becoming purulent by a timely withdrawal of the liquid. I have suspected this on two or three occasions, particularly in children (who are so prone to empyema) recovering from pneumonia, who have had incessant signs of effusing and in whom on exploration, a turbid liquid has manifested itself, this being subsequently withdrawn has proved to be salmon in amount and has not re-collected. I am disposed to think that there were cases which would have become empyema had the liquid been allowed to go on accumulating. This impression, together with the fact that there are certain primary pleurises having a tendency to
became supplicative if their effusions are allowed to remain too long, again reminds one of the impossibility of separating perfectly the serous from the purulent coats, and all the transition variations known to exist between the one and the other; and since the latter may be regarded as very early suppurative (when the fluid is serum-suppurative) it will be necessary for me to speak of the methods of treating them as well as of those employed in cases fully suppurative.

I am well aware that it is by many thought-dubious and to help a simple inflammatory effusion; not only an account of the risk of introducing some caustic material which would convert it into an empyema, but also because it has been stated that the interference with an acutely inflamed serous membrane, and the removal of its normal inflammatory exudation so apt to be followed by a positive result, quite apart from the question of suppuration. Of the former accoutre there can be no doubt, and the means for preventing it are sufficiently obvious; but of the latter I am very skeptical, for my own experience has been that nothing but advantage ensues from the withdrawal, partial or complete, of an inflammatory exudation which is causing distress by its mechanical interference with respiration and circulation, and in the great majority of cases the inflammatory action seems to be relieved rather than increased after paracentesis, one may judge by the diminished fever and improved digestive functions which so often ensue, together with the sentiment-circumstance that the execution, which is the resultant of the inflammation, almost never re-occurs, or if only partially, the absorption of the remainder is often lamented about. It must not be understood that I advocate paracentesis immediately the effusion has become evident, in a case of pleurisy, by contention simply being that it should not be allowed to go on collecting after the lapse of a few days.
On the other hand it is the common experience that an effusion which is increasing or which shows no tendency to become reabsorbed is harmful to the patient, not only immediately, but it may become so eventually, either by causing damage to the lung, leading to its being bound down by lymph, which cannot break away, or by becoming converted into an empyema. These considerations which have led me not to press therapeutic measures to the conclusion of operative ones even in cases of moderate inflammatory effusions where recurrence is going on, high and sharp them as valuable adjuncts. It is admitted that absorption can be brought about in many instances even by simple effusion by purely medical means, but in view of the fact that relapse is so readily attained by Nature, and that its careful performance will, instead of neutralizing danger, be likely to promote convenience and prevent ultimate risk, there need in my opinion be little hesitation in removing the fluid after only a few days. In brief then any recommendation is that if an inflammatory effusion is per se causing symptoms of disease, it is better to remove it than to wait until it attains any particular level, and on no account should it be allowed to remain at all if an exploration shows the appearance of under going a supervened transformation; for if removed at the stage of simple turbidity the complete transition into pus may possibly be prevented. This point is illustrated by a case which I saw in consultation a year ago; the patient being a clack, who, after an attack of hooping-cough, remained in a weakly condition for some time and at length got an attack of pneumonia involving the lower lobe of the left lung. Instead of clearing up, after an imperfect crisis there was continued dyspnoea and feverishness, and on examining the chest there was weak tubular breathing at the
left back posteriorly, absence of friction, but well marked dyspnoe
and dulness on percussion. With the aspirator the sources of very turbi
d fluid were withdrawn, and often thus the physical signs and pain
quickly cleared up and recovery was established shortly afterwards.
It is interesting to look back upon the experiences which we had
in the past ten years during residence in various hospitals and
in my own practice, and to note that the cases of thoracic effusion were
very treat with the aspirator during the first year or two of
th period, whereas was the trocar, which was then in favour,
so seldom employed in serious conditions. In determining the
relative merits of these two instruments at that time we often
heard it alleged that the aspirator, by forcibly withdrawing the
fluid, was able to cause an active filling of the pulmonary vessels
that a dangerous occlusion was liable to occur, and the trocar
was preferred by many, mainly because the fluid would only
escape until the pressure in the chest had become equalised
with that external to it. But there was one real danger, namely
avoided by all. The physicians, with whom I had the privilege of
working, namely, the entrance of air, which, whatever may be said
of its consequences, was unstintedly sometimes followed by the
transformation of these previously effusion into fluctuant ones; and partly
to avoid this accident and in part to exercise a moderate effect
like action, the enferma was generally attached to a rubber tube
which dipped, at or near the floor level under a solution of
caustic acid. The late Dr. Martin Key, who in 1844 was physician
to the Liverpool Infirmary for Children, used to impress upon me
the importance of allowing the chest to become emptied slowly, in order
that the lung might become gradually expanded, and to attempt
this he employed an ordinary short Souleau cannula, having it—
official cæsarean. The root of the long bistoury (antistomy)
departed in oil, and set alight, was frequently employed (as
noted by Paulus Aegina) in preference to the hot iron.
From this Arabic period up to the nineteenth century there were
not many writers who advocated operative measures, and
those who ventured to open the chest followed the Hippocratic
direction; the only difference of opinion being as to whether
it was better to use the knife, or the cautery, or a combination
of a cautery which produced a superficial ulcer, with the
knife, which was subsequently employed to complete the
perforation of the soft parts; the advantage claimed for the
latter method and for the actual cautery over the simple
incision with the knife probably having been that the former
was less likely to heal too quickly. But during this period
operations for the relief of intrathoracic effusions of whatever
nature—the result of traumaism (where there were perforating
wounds) were performed, and a good deal of discussion
seems to have taken place as to whether, it was better in this
case simply to dilate the original wound or to make a
counter opening; some writers advocating this latter as a rule
whence signs of effusion followed a wound, and the former in
every case in which penetration of the thorax had occurred,
to effect a sufficient outlet for blood, or for pus if any
subsequently collected. On one further point there was
some controversy, namely, regarding the most suitable
situation in which to make the opening, whether the case
was one arising from a perforating wound or not. All
seemed anxious to operate as low down as possible, some
choosing the 9th, but most recommending the 8th interspace.
long capillary tube was conducted into a vessel containing a measured quantity of carbolic solution. In early cases of pleuritic effusion, while working with Dr. Ogle and with Mr. Tyler, I was at the time

hospital and made a note of the results obtained by this method of drainage. They were in general good; provided a free flow was maintained, but the difficulty of sustaining this was always so great—the capillary tube or cannula becoming blocked with suspense, that before my period of presidency was completed, Sothys's cannula and tube were abandoned, and an instrument of wider caliber substituted. I learnt two lessons however from the employment of

Sothys—One being the unsuitability of carbolic acid for being brought into contact with susceptible tissues in some cases, and the other—The danger of inserting a glass instrument over a long ridge like the ribs. The very last case in which I used Sothys's cannula was, it impinged on the rib, and the inner fragment was only extracted with the greatest difficulty. The ordinary burr and cannula with its attached rubber suction tube also gave very good results in these cases—one of the larger cases Dr. D'audigny cannula being ordinary employed. I have nothing to say against

this method, beyond stating that it requires constant watching lest the end of the tube gets out of the antiseptic solution, that it is very liable to become blocked, and that little advantage accrued from this slow and sometimes painful process over the simpler operation of aspiration, which we know from experience to be speedy and certainly not more unsafe than any of these other arrangements complicated with tubes and cannulas.

Of late years I have employed the aspirator exclusively for chronic effusions of all kinds, and I cannot remember having seen anything

approaching a serious sequel to its use.
associated with aspiration of the chest are dependent upon the kind of instrument employed and although every credit is due to Dinsley for having introduced this method, I fancy it is not like his instrument. It is too apt to fall out of order, the rule rather than the exception being that if worked in a hurry, the piston is too stiff to move or too dried up to cause a vacuum, and what is of more importance, it only too often happens that the jetting, one not air-tight and that a mixture of air and serum entering the cylinder, the former is apt to find its way into the thoracic cavity of the resuscitation action is stopped, thus again unless great care is taken an accident will sometimes happen through the tap or taps being turned wrongly. The fact that fluid can be forced into the chest with the aspirator to wash out the pleural cavity was formerly stated to be one of its advantages, a very physical one, and I shall presently show when speaking of the possible injections of fluid into the thorax; and if with a faulty instrument which has admitted air, or one which may have escaped being removed thoroughly antiseptic for a former aspiration, some infected fluid is returned into the chest, one need hardly say that the greatest advantage of the aspirator is defeated. The aspirator should never be devised so as to receive the expelled products into its cylinder, and it should be of the simplest possible construction; the vacuum being produced in a bottle having a capacity of about two pints. This type of instrument has the additional advantage that as the bottle fills, the vacuum becomes relaxed and the fluid is withdrawn with less and less force as the operation proceeds, so that the danger of causing undue traction upon and expansion of the lung is minimised, whereas the instrument of the Dinsley type causes the same amount of pressure with each withdrawal of the piston.
The "bottle" respirators are very serviceable and unlikely to fall out of order, some of them are provided with hollow needles which require the serration not to injure the lung with the sharp point; others by having a sharpened cannula through which a trocar passes, and the construction is such that, by means of a stirrup on the proximal side of a projecting arm, to which the tube of the aspirator is attached, the trocar can be withdrawn without allowing air to enter. In addition to the advantage which this blunt cannula affords, it should be mentioned that if the latter became plugged with coagula or fibrous matter, a blunt-stilette can be inserted to clear it.

Regarding the site for operation:—I believe the seventh intercostal, in or about an inch behind the posterior axillary line is best for reasons which I shall adduce when speaking of the operation for empyema. It is a good plan to extend the arm over the head (which place the body towards the sound side) while operating, because by so doing, in addition to giving more room, the skin puncture does not coincide with the muscular one or again placing the arm on the side, the puncture should never be made higher than the middle of the interspace and care should be taken to direct the point of the needle horizontally, in order to avoid injuring the intercostal vessel alone, put the diaphragm below, and the greatest care should also be taken to guide the instrument with the finger placed on the interspace, to avoid striking the rib.

A very common cause of the pain which is so often spoken of as being one of the dangers of paracentesis, is shock—caused by the perforation of the skin. This pain has seemed to me to depend upon this much more frequently than upon the withdrawal of the fluid, and I think it should be an invariable rule to
produce local anesthesia by pressing either with ice and salt, or allidone
de, or ether. These are dangerous to use quickly, and
what is of so great importance. Suddenly, with one steady push
generating a structure of the chest wall, if this be done, failure
to obtain fluid through pushing the thickened pleura before the instrument
(which is one of the recognized causes of obstruction in this operation)
will seldom occur. I have never witnessed either complete collapse
or sudden death from pericarditis but that they have occurred both
during and after the operation is undertaken. The latter has been avoided
to the separation of sutures from the displaced vessels.

It is not easy to lay down rules regarding the amount of fluid which
should be withdrawn and each ease has its own needs. Some under the impression however that a relatively
larger amount may be extracted in acute than in chronic effusion
due to greater probability that the absorption of the former
will take place. I think it neither necessary nor expedient
to aspirate all the fluid in every case for whenever the
tension is relieved the inflammation becomes lessened and
absorption commences and the lung being as yet unattended
by thickened effusion readily expands. In general I have
been guided by the patient's sensations and have allowed the
fluid to escape so long as he remains comfortable, but if there
is very troublesome cough, or pain, or if the escaping liquid
becomes markedly blood-stained I have withdrawn the needle
and covered the puncture with an antiseptic plaster.

Such variations as have taken place in the treatment of
emphysema during the past ten years have been in the method of
after treatment-rather than in the principle of the operation. They
being very few surgeons now who advocate pericarditis with the trocar.
of any of its modifications in preference to the free incision of the chest.
I have seen the aspirator used a good many times, and have on
one occasion, in the case of a child, found it to be useless. This was
however an exception to the usual sequel of any method of operating which
does not provide prolonged and free drainage, and was, this principle
being recognized, most operators prefer to make a single free incision,
which is subsequently kept patent by means of a large drainage tube
until the discharge ceases and the lung becomes expanded.

In the case of Tyson already referred to some complication by aspira-
tion occurred; I have often thought that the aspirator may have been responsible
for the localization of the pus. It was employed in the first place because
the secretion was thought to be serious, but proving inefficient, it was
withdrawn to relieve symptoms. The visceral relations were re-
stored to the normal, and after the operation there remained no
appreciable evidence of a retention of matter in the anterior part of the
chest. Four days later, however, the chest was again full of pus
and an incision was made immediately below the point where
aspiration had been performed (in the left 6th interspace in the line of
the scapular angle), but greatly to my disappointment only three or
five ounces of pus were discharged, and although posteriorly and below the percussion
note was rendered more resonant, it was evident from the con-
tinued cardiac displacement and other signs, that a considerable
amount of fluid was retained in front of the posterior axillary
line; so the chest was again incised two days afterwards in the
seventh interspace in the anterior axillary line, when about ten
ounces of sweet pus were discharged and the patient, a man of 34,
made a good recovery. This case made me suspect that the
adhesion took place after the aspiration, and the pus of air collecting
had become divided into two portions. Since this experience I have
preferred not to withdraw any instruments after the aspiration, in case of complicating the subsequent treatment.

There are some surgeons who prefer to make two openings, in every case of empyema, in order to effect thorough drainage and to prevent the retention of any matter after the pressure in and out of the thorax had become equalized. I have had no personal experience of this double incision, nor can I see what advantage can come of it unless in the after-treatment it is proposed to waste out the chest. If this is done as a routine practice, I agree that it is important to have some such means of preventing active pressure upon the pleura (see page 17) but since the cases actually requiring this treatment are few and far between there can be little objection in anticipating its necessity by having a counter-opening in every case.

Although in inflammatory conditions of a chronic character there is some difference of opinion as to the wisdom of early punctures, there can be no question as to when an empyema should be opened; for whenever an effusion is found to be purulent, the sooner it is let out the better and the more probably will there be of an early recovery. Sometimes it has been argued that the patient should be allowed to rest, and that this nutrition should be improved by careful dieting before operation, but when we consider that the aids to the lung are enhanced by every delay, and that the loss of nutrition and vitality are but symptoms of the disease, the rational procedure is surely to remove the offending matter both as little delay as possible.

The acute empyema like the acute abscess in any other situation is much more amenable to treatment than one of chronic type. But it differs from most abscesses in that puncturing of the pus is rare, because the tension is exerted upon movable and compressible structures, which must be greatly displaced before any localized penetration can be effected.
and the aim in treating any case must be to relieve that tension as early as possible, in order that the lung may quickly re-expand, and its pleura become thicken as little as possible.

I have seen several cases where comparatively early thoracentesis was performed (of which Gregor, page 111, and Dineen, p. 63, are examples) followed by contracted sides, indicating that the expansibility of the lung may be impaired very early; and next, cases of chronic effusion depend upon the lung being so bound down that the vesicle and pleural pleura cannot be brought into opposition.

Such diversity of opinion seems to exist as to the best spot in which to make the incision when performing thoracentesis. Some have a point of preference, but many others incise at any situation in the lower part of the thorax, where pus has been discharged with the exploring syringe. I have seen some few cases operated upon anteriorly, between the nipple line and the anterior axillary line; as good many have been opened laterally, and in may cases the incision has invariably been made posteriorly, or directed correctly-posters laterally. Most of those who prefer to operate in front of the posterior axillary line, do so because there is more room between the ribs as they are traced forwards; but I have not observed any very great difficulty in obtaining free drainage from the posterior incision, and my impression is that the cases run a shorter course with this than when a more anteroposterior is selected, and I think too that scientifically it is more correct to choose the former for the following reasons: (1) With the patient lying on his back or on the side, the aperture for drainage is independent. (2) The base of the pleural cavity is carried upward, and corresponding to the arch of the diaphragm, is considerably deeper posteriorly than anteriorly and laterally. The relation of the
Expiration

Lung to upper border of 6th rib.

Diaphragm

Liver

Inspection

Lung

Diaphragm

Liver

Pluma below 10th

Lung to 9th

9

10

Testut
autonom pleural border being; - On the right side - After running downward behind the sternum to the euriform cartilage, it passes outward upon the seventh costal cartilage - then across the eighth and ninth, meeting the twelfth rib in the axillary line; thence it passes along the eleventh rib, reaching the vertebral column at the neck of the twelfth rib.

On the left side; - the pleural border passes downward and outward behind the fourth space, fifth costal cartilage, fifth space, sixth costal cartilage - along the seventh and across the eighth, ninth to tenth ribs, reaching the lower border of the latter in the axillary line, being here somewhat deeper than on the other side; at the lower border of the eleventh rib, the pleura then passes along the eleventh rib to the neck and head of the twelfth rib.

It correspondence with the foregoing the diaphragm is higher anteriorly and laterally than posteriorly; in the diagram shows the relationship of the lung to the chest wall during inspiration and expiration.

With the patient lying in this back there will be free drainage with a posterior incision, not only because of its greater depth, but also because the fluids will gravitate along the sloping line of the pleural border, and can be allowed to escape from a lower interspace than can be opened with safety either in the axilla or anterior to it. It is very important to remember the above anatomical facts, firstly because drainage from the axilla does not insure the emptying of the posterior cul de sac; and secondly and very importantly because it will prevent a mistake which I once encountered in the opening of the peritoneal cavity and wounding of the liver through making an opening in too low an interspace in the anterior axillary line.

Every medical man who has had practical experience in performing thoracentesis, will have met with a case in which difficulty has been encountered in finding
The way into the thoracic cavity with a director or tube, through the wound out of which the pus may be escaping at the moment. This is generally the result of some alteration taking place in the muscular posterior, due to the position of the patient being different before and after making the incision. This muscular difficulty has been acted as an additional reason for making an anterolateral incision, the muscles being thinner anteriorly than posteriorly. In the patient a few days however, there is very little muscular covering over the seventh and ninth intercostal spaces, and these spaces constitute the seat of danger at which any care has been operated upon.

With this preference for a posterior lateral incision, one must always as a matter of routine make sure with the exploring syringe that pus is present at the spot to be operated upon, else there will be the danger of cutting down upon an adhesion or of otherwise missing the pus.

With reference to the operation there is little to say except that the opening in the pleura should be ample and large enough to admit a drainage tube having as wide a diameter as possible. (From 3 to 4")

Generally after incising the pleura the wound has been enlarged with a probe pointed knife guided upon a director, or by fingers directed.

In my earlier hospital days it was customary to insert a very long tube—from four to ten or more inches in length (the width of the tube being sacrificed to its length). This was shortened gradually until at last it just projected into the pleural cavity. These long tubes fulfilled no useful purpose so far as one can judge, and were often a misfortune. A shorter tube is used, the case having neither been of longer duration nor having evidence of insufficient drainage been apparent. Two or three inches are the limits of length which I have found necessary, my feeling being that a long tube is more apt to become
In account of the danger of injuring the diaphragm in the former
and Saliot and Blumlein added the further precaution, that
care is to be taken to avoid the origins of the vessels. In all
the cases, injections of wine or of honey water were employed
and in other respects the after treatment was not different
from that of the accidents.

The next step in the history of our subject, began during the latter
half of the Sixteenth century, when once again, despite considerable
effortful empiricism came to be regarded surgically and there
was more tendency to treat them by incision and some
practitioners seem about this period to have reintroduced
perforation of the ribs or sternum; a practice which had
been but little employed since the time of Galen. It is
rather difficult to comprehend the circumstance that
no injuries to the intercostal arteries are recorded by the
advocates of this plan, but we may perhaps infer that
accidents to the vessels were not unknown to the operators
from the fact that although we may judge from another
Part's article on Empyema that he was unfavourable to
interference with the vessels structures because of the
difficulty of making certain that the flow could be
ample, yet in advocating incision through the intercostal
spaces he gives the caution that when the knife is
employed, it should not be directed too obliquely
downwards for fear of wounding the intercostal arteries.
And Part also made use of this trepan in cases where his
patient was large chested or had very large ribs, presumably
on account of his being able in these cases to get a sufficiently
large opening to secure efficient drainage. At this period

Paris 1879.
blocked or compressed than one which does not project far beyond
the internal opening of the wound. The double drainage tube is
not necessary unless it is desirable to wash out the chest cavity.
Occasionally a tracheotomy tube has been employed and the metal
one has proved useful; it has the disadvantage that by pressing on
the side it may lead to necrosis. Morrison's and rubber
tracheotomy tube has never proved a success in my hands, its caliber
is too narrow and it tends to kink and to interfere with free drainage.
The tube having been inserted, it is guarded in the usual way
with a safety pin and a piece of sterile gauze is interposed between this
and the skin. The usual absorbent antiseptic dressings are used
and after the first day or two they may often be left undisturbed
for several days.

Evacuation of a portion of the pleural cavity to give more room for drainage in acute
empyema is a measure which does not commend itself to me,
for the simple reason that cases do just as well without it.
I have not experienced inconvenience from the interposing gauze to
narrow either in children or where by contraction of the chest after
evacuation of the pus the ribs have become somewhat closer than
usual, and I can see no object in increasing the extent of the
operation. It was done lately in one of my own cases by my
surgical colleague, and the patient made an excellent recovery,
but I believe the result would have been as good without it. The
operation was performed sub peritoneally and practically painless.
On the other hand, the necessity for this
procedure becomes apparent in chronic cases, where the ribs will
not and cannot be displaced owing to the non-plasticity of the lung;
these cases result from delayed operation at an early stage
and they are very difficult to deal with. In one case which I
now at Penclelary where resident there, after resection of the ribs.
The hopelessness of ever getting the lung expanded or the chest wall sufficiently contracted without operation was dem-
strated by the way in which the
exposed pleura fell in, after the
resection of the ribs. Another Penclelary
case which I show the photograp-
ph gives some idea of the amount
of contraction of the side, and deforma-
sity of the spinal column on which
may follow this operation.

After Treatment

In accordance with modern antiseptic methods, after the first copious dis-
charges of pus have ceased (accompanied frequent renewal of the dressing)
the wound is covered with a thick pad of wool with (calcinated) or other
antiseptic and absorbent dressing, and this is changed only once each
day at first—then less or less frequently according to the amount of discharge.
If the pus is present when the thorax is opened, or if it subsequently
becomes so, it is sometimes advisable to wash out the chest cavity
with a warm antiseptic solution, corrosive acid being the one generally
used—and in those cases where there is long continued discharge
showing little tendency to lessen the same process is adopted, the
solution repeated as well as antiseptic being called into
repetition. I mention this latter in particular because at one
time it was the custom to wash out the chest in nearly every
case and it was my fortune, or misfortune, while performing
this operation in 1884 to meet with an accident of which there
are only a few recorded cases, I refer to the occurrence of convulsions, to which attention was mainly directed in this country by Dr. Calley, in the Clinical Society Transactions, Vol. 2. 1877, page 16. He had a fatal case and he refers to several other cases under the care of continental practitioners (Dr. Yarnton, Keynsham & Dray). There has never been anything found post-mortem to account for this most alarming complication which seems to differ entirely from the cases of sudden death following paroxysms, generally ascribed to embolism from some clot broken by the alteration in the situation of the bloodvessel (or its tributary) or by simple syncope (Broadbent). In reading the older authors, I have several times come across descriptions of cases where wounds of the thorax were followed by epileptic attacks, which were probably similar in their nature to the case now referred to, but their convulsive seizures due to the injection of fluid into the chest must be rare, because they are not mentioned by so accurate an observer as Lusseras, nor by many others, ancient and modern, who not only practiced it but effected the entry of the fluid forcibly by means of a syringe. It is evident from my own practical experience and from Dr. Calley's case that the convulsive attack was caused by the endeavour to force a larger quantity of fluid than usual through the veins. So long as no very active pressure was brought to bear on the cavity no harm resulted, but immediately force was employed the attack was precipitated.

Whenever it has been necessary to inject a chest, since my own case occurred, I have been careful to have two tubes in the veins so that one of them might constitute an aperture of great for the fluid and to prevent any great extra thoracic pressure. (The convulsions are ascribed to over-stimulation of the vagus.) It is rather curious that I happened to be using a weak solution of iodine at
The case—this being the same agent which Mr. Caley was injecting, but it is unlikely that the drug had anything to do with the matter since it had been so often used previously in both cases, without ill effect. There is no great distinction between any case and must others recorded in that the boy recovered a result which I attribute to the prolonged administration of chloroform. His eczema at length became perfectly well although the chest was never again washed out.

Case:—William Wilkins aged 5, was admitted into the Liverpool Infirmary for children (under the care of Dr. Green) to whom I am indebted for permission to relate the case on October 2nd 1844—suffering from left lung pneuma.

The pus was escaping from an aperture where it had spontaneously perforated and burst. The pleural was three months ago and was convertible to an attack of scarletina with syringy. The sinus was at once enlarged and a drainage tube four inches long inserted. This tube was left in the pleural cavity on October 10th. The chest was washed out daily with a one per cent solution of boric acid from the time of his admission until December 17th. He was allowed to lie up and about the ward, was placed on a liberal diet and had lost liver oil and double of iron. The discharges which were copious, varied in amount, but showed no signs of ceasing in which account a solution of boracic (one dram of the mixture to a pint of water) was substituted for the boracic lotion (see 4th). These injections were always performed into the chest from a vessel alone the bed. The discharge at once began to lessen from the use of the cocaine and on December the 17th both the drainage tube and the injections were omitted. On January 6th 1845 the temperature which had previously been normal was noted as having been very high during the last two nights. The breath sounds, which had showed
January 7\textsuperscript{th}. The temperature continues to rise at night and a slight discharge of pus is taking place from the ears. This was again dilated, and a large escape of pus took place. A tube was inserted and the injections withrende were resumed.

January 14\textsuperscript{th}. The temperature has not been above normal since the tube was introduced; the cavity is being washed out with the iodine every other day. The tube remained today. Discharge slight.

January 20\textsuperscript{th}. The syringe used for making the injections being not good, a large syringe with india rubber tube attached was used for washing out the chest, and when about half a syringe full had been slowly injected - the boy suddenly complained of pain in the side, and almost immediately lost consciousness, going into a condition of tonic spasm. The eyes both turned to the right and upward, both upper extremities were rigid, the left more especially. He became very pale; the drooping arm was in a condition of flaccid spasm. Shortly he uttered some loud cries, became unable to move at frequent intervals, and became convulsed. The left extremities jerking more than the right. He vomited several times, and appeared to be unconscious when the chlorine ceased.

Half an hour later - 12\textsuperscript{th} hour - he again went into general convulsions, there was great twitching of the arms and legs, more especially the left, and the face was drawn to the left side. He vomited once while conscious. In a few minutes he became quiet, but was quite unconscious; the face very pale, abdomen retracted, pupils widely dilated, the left more so than the right, and the face remained drawn to the left. There was occasional twitching of the right side.
He remained in this condition until 9 p.m., when he again became conscious and remained so for half an hour; then came another period of unconsciousness, and then another recurrence of the convulsions at 10 to 11 p.m. This time they persisted (in spite of rectine injections of chloral hydrate, and other means) until 4 to 5 p.m. He was in a state of stupor, every part being stiff; rigid and then convulsed.

The temperature in the rectum was normal. He defaecated and urinated unconsciously. The pupils were dilated, especially the left and were insensitive to light. The movements were especially violent on the left side, both in the limbs and trunk in the face.

Alloform was at this time given (4.30 p.m.) and under its influence the clinical movement gradually subsided until at 4.40 p.m. they had entirely ceased. Alloform was administered at intervals until 6.30 p.m., when it was discontinued: but he soon had a return of the convulsions—violently in the left leg and slightly in the right arm until the Alloform was again given and was continued until 9.30 p.m., when to this time, whenever he came from under its influence the twitchings recurred. At 10 p.m. he was allowed to come round since he did not appear to show any tendency to have convulsions and he lay quiet, looking about him. He took some nourishment and was given a dose of chloral and bromide, after which he slept for some hours.

On the following day, January 21st, it was noticed that there was some weakness of the left arm and hand, and strabismus of the left eye (direction not stated in notes). He was very restless during the night, frequently screamed out, and apparently had some delirium.

He is now (10 a.m.) altered mentally—says he does not know who he is, and does not know his mother; who has been sitting with him. Says he has had no pain except in the side (pointing to the sinew.)
10 pm, has been sleeping quietly all day, waking up just occasionally
asking for milk. He seems to have some hallucinations — asks me
to take away the boys from the bottom of his bed. He also wants to sit
in a chair which he points to in the region of the ceiling. He does not
yet know me. The paresis is less marked.

January 23rd. Slept soundly all night — seems much better generally
but the peculiar mental condition continues. In the evening talked
much nonsense. He sleeps most of the time.

January 25th is much better and quite rational, called me by my
name. The paresis in the left arm and hand is quite gone.

January 24th a long drainage tube was introduced into the cavity
injections were not again employed.

On January 25th and 26th there was a copious discharge of purp blood stool.

January 27th - He developed chicken pox and was removed to an
isolation ward; after recovering he was discharged on Feb 19th.

March 26th examined in the out-patient room - the stools were still
discharging and the side much contracted. Breath sounds weak
respiratory. Some crepitations audible throughout.

Later in the year he was again taken into the hospital. Nothing
of severe note was removed. The last drainage tube was
removed from the pleural cavity, and eventually he made
a good recovery.

There is just one other point requiring some mention in this section, namely
the treatment of suppuration of necessity and of cases where there is a similar
picture. They are more or less analogous, the latter being a case in which
the pus has pointed internally instead of externally. One has
often heard it said that a pointing suppurative should be inoculated
over the swelling, and indeed it was for long considered that these
cases afforded a better prospect where to treat, than cases where no
external swelling appeared. This however is certainly not universally
the case; for free drainage is very difficult (the external swelling being
actuated anteriorly, close to the sternum) and there is a considerable
inclination for them to become chronic. If an ordinary operation is
treated by double incision, one in front and the other behind, the
internal opening will generally close long before the posterior one—when the
patient is confined to bed—and the case related at page proves how a close
envelope, discharging from an anterior wound (originally an envelope of
necessity) was improved and eventually relieved entirely cured by
marking a counter opening posteriorly. My belief is that it is best,
where there is an anterior pocketing of the pus, to make the usual
posterior incision, to ensure thorough drainage as before explained.
Case 13. B. female 7 years was taken in May 1st 1883 with pain in
the side "like a stitch." This lasted for two weeks and was followed
by approximation, vomiting &c. On June 26th a swelling was noticed on the front
of the chest, which increased in size daily. She was admitted to the
children's Hospital, Pendlebury on June 27th. She was a thin, emaciated
looking child; her complexion dull and her fingers and mammae clubbed.
The left side presented a swelling over an area of three inches, the
centre of which was the nipple. The veins were distended over it. On
the left side the percussion note was dull throughout; Vocal resonance
diminished, the breath sounds weak and typical in character; the
right side was resonant throughout. Breath ENERGIZED uncom-
plained by pain plethoric. The heart beat was audible from the epigastrium
to the right nipple and most plainly palpable in the 4th right intercostal
just at the nipple. The chest was opened just below the angle of
the scapula in June 27th and eleven ounces of serous, cloudy fluid
escaped. The anterior swelling had entirely disappeared on

June 30th. The temperature did not rise above the normal after July 3rd, but the discharge continued until September 4th, when the tube was left out and she left the hospital, cured on September 30th.

Exactly the same principle applies to cases of bronchial fistula, of recent or if there is pneumothorax and continued collection of pus in the chest; but before performing thoracotomy in any of these cases, it is of great importance to be assured of the presence of the fist by means of the exploring syringe.

**Double Empyema**

Of this condition I have only heard one case, which has already been incidentally referred to several times. There are many instances however recorded by authors of nearly every period in the history of the disease, but comparatively recently it was looked upon as of much greater consequence than when unilateral. The older classic writers invariably advised that only one side should be operated upon at first, then at a subsequent period, and it was thought that by opening both at once the lungs would collapse and respiration become impossible. This impression has been based upon the circumstance that puncture of the healthy pleura gives rise in some cases to respiratory and artificial means (some military records state that wound puncturing the pleura gave rise to collapse of the lung in some cases, not in others) owing to the elastic recoil of the lung: this has been repeatedly demonstrated by puncturing the thorax of an animal with a cannula connected with a water manometer. As further evidence of this danger, such cases as those mentioned by Watson (Principles & Practice of Medicine Vol. VII, p. 499) where the healthy side was opened individually for the diseased one, have doubtless contributed to deter practitioners.
from performing the double operation at or about the same time. When the above error in diagnosis was made, death took place in four
the chest in the two cases quoted by Bateman, in three minutes.

Of Sidney, England, and by Dr. Maurice Boulé published a case of double
empyema, cured by simultaneous drainage of the pleural cavities
in the Clinical Society Transactions for 1741, and they quote a good
many cases recorded by others. They remark upon the advisability
of opening the left side of the chest first, a recommendation which
should always be followed for the reasons which they give:—that the
ventilatory embarrassment is thus relieved, and the second operation
likely to be better borne. In my own case the left side was opened
first, the double nature of the disease not being suspected until after-
wards. An anesthetic was given (ether) but the cyanosis became so
great that when the second incision was made a few days later
no other was administered and the operation was performed with
little pain by thoroughly freezing the part with alcohol of Eich.
The main features of this case have already been related when
speaking of cardiac displacements at page 63, and I need only here
resemble the circumstance that the right chest was freely opened
four days after the incision of the left one, and that with this
simultaneous drainage the patient (who became delirious) was relieved
from the dyspnoea to which he had previously suffered.

The fact that when both the lungs have been compressed by fluid,
pleurisy, and with distress follows the opening of both pleural cavities, opens
up the whole question as to the means by which the lung becomes
expanded in any case of empyema—single or double. After incision
I have frequently noted that on inserting a probe into the sinus
in cases of empyema undergoing treatment, the lung can be felt
within an inch or so, and sometimes its expansion and contraction
There were several other well-known men who did much to re-establish these operative measures and to render them more successful; among these were Marcello Bonate and Fabricius. The former attached great importance to the study of the success of the operation and the latter especially seems to have given the matter much study to have laid down very definite rules for its performance. He considered that the 6th interspace from five fingers length away from the sternum was the most suitable site for incision, thus avoiding the thinner muscles further back; but he also described a method whereby the point of puncture might be determined by measurement, the length of the scapular being taken with a thread, and the point chosen being distant one third of its length from the sternum. Will he made his incision parallel to the direction of the plane of the external intercostal muscles and it is interesting to note that he was among the first to point out the importance of keeping close to the upper border of the inferior rib, in order to avoid wounding the vessels. While protecting the chest he directed the patient to make an inspiration in order that the diaphragm might be protected. Both Marcello Bonate and Fabricius made use of cammelia after opening the chest, through which they injected fluids to dilute and wash out the pus (which was only allowed to escape little by little) the one employed by the latter being specified as circular in shape, pierced with holes, and furnished with two wings which prevented it from slipping into the thoracic cavity.

Early in the seventeenth century we find for the first time that some attempt was made to break through the traditional practice of keeping
can be observed by the way in which it moves the probe. Their gradual expansion of the lung is also proved by the sucking out of the drainage tube, so that it is certain that expansion does take place whilst the operation wound is not closed. The exact mechanism by which this is effected requires elucidation by experiment, but some surmise may be made by clinical and pathological examination. In the case referred to above, before the operation there was very great respiratory distress, and the thoracic movements were shallow, whereas on relieving the lungs from the pressure of the fluid the distress was manifestly lessened, and the respiratory field, after opening the left side, from a maximum of 42- to a maximum of 30 per minute; and after the second operation from a maximum of 30 to 20 per minute on the following morning. Therefore, the presence of active pressure by the fluid caused certainly more anguish than the absence of negative pressure when both chest cavities were opened up, and evidently some expansion instead of further collapse took place.

Several theories, some of them supported by experiment, have been formulated to explain this pulmonary expansion. Some have thought the presence of the dressing on the wound cause by sealing it, or by forming a vacuum opening, aided expansion; others have said that adhesions exist in most cases and prevent complete retraction and a third explanation was suggested by Dr. Samuel Bell (Brodhun Lect., 1857) who pointed out the cohesive force which exists between visceral surfaces when in apposition with one another, and which resides very considerably attempts to separate them even when a probe is inserted between their margins. When a lung retracts, it appears to do so by a sliding of the visceral upon the parietal pleura, and when a chest contains fluid these two
pleural surfaces must remain in complete apposition, except
where separated by the fluid, and when the tension is removed, the
expanding and perhaps an involuting closure of the pleura and ex-
piratory effort will cause the lung to expand as the fluid
escapes; the visceral pleura sliding over the parietal and gaining
ground which is retained by this cohesive property which Dr. West
has demonstrated. It is quite possible that this cohesive
force becomes gradually aided by the formation of adhesions; and
post-mortal examinations almost invariably prove these to be
present to some extent, great or small. There is a record
of a fatal case of double emphysema in the Edinburgh Medical
Journal, 1844 (a case which I did not see) where many such adhesions
existed. The right chest was opened on March 7, fourteen weeks
of pus escaping. The left one was opened on March 22, a little
more pus being evacuated, but much more came away later.
There was much diyphormia, unrelieved by keeping the wounds
covered with plasters. There is nothing of clinical interest to record
beyond the persistence of hectic, which continued until the child's
death on May 15th, at 6 years.

Post Mortem:—The right lung was firmly adherent posteriorly and
as far forward as the mid-axillary line. In front of this there was a
cavity reaching from the hilus pleura to the apex. The pleura was about 1/4
thick of fibrosis. The lung was well in contact with the chest wall
anteriorly. Between the base of the lung and the diaphragm was a definite
cavity containing fluid. The pleura was adherent to the pericardium.

Left Lung:—was adherent anteriorly as far as the 3rd rib, as well as
throughout posteriorly, but laterally there was a cavity reaching up to the apex
(by these cavities were adherent portions of the pleura are evidently meant).
The upper lobes of both lungs were flabby and quite airless. The lower
The following abstract from my own notes, is from a case which is perhaps
more instructive, since the child recovered from the erysipelas, but
died of erysipelas eight weeks later. The scirrhus was entirely healed on February
21st, 1844 and it died on Jan 19th, 1845.

Case - No. 65. A Fick born 6th 14 months had been ailing since an attack
of measles three months before she came under observation on Sept.
21st, 1844. When she was found to have a right-sided erysipelas.
This was opened and freely drained, after which the scirrhus eroded
in depth so that whereas she was at first so weak as to be unable
to sit up, and only weighed 7 lbs. 6 oz. after four weeks her weight
had increased to 15 lbs. The chest was washed out daily, at first
with tepid boracic lotion, but by November 1st the discharges had
abated and on Dec 15th the tube was left out. She was however re-
collected presenting the reincorporation of the blade a couple of days
later, but on Dec 19th it was finally withdrawn and by Dec 27th
the scirrhus was healed. The breath sounds remained indistinct
on her chest and the percussion note was dull all over the right back
posteriorly, but this diminution had greatly diminished and the Alexis
breath sounds were plainly audible at the time of her discharge
from the hospital on December 27th. On January 14th, 1845
The mother called to say that the child had been ailing with erysipelas
and had died that morning. I made a post mortem at
her home 24 hours after death. - Rigor slight except in jaw.
There was little expectorated material. Body fairly nourished. The
scirrhus was entirely healed up, its situation being marked by a
hard, smooth cicatrix. The pleura was not fluid the right
pleural cavity contained no fluid, the pleura was thickened
at the base and was slightly adherent about the middle third
of its content in the said antral discs. The right lung was somewhat solid and of a purplish-btnate colour towards its base; its put floats in water (probably an area not yet sealed after the inunction). The upper two-thirds was crepitate and an excreting much fusty sound then took place from the cut surface. Left lung—healthily. A thick layer of false membrane and fluid the whole extent of the trachea and larynx. The cords were thickened and covered with false membrane. There were no pulmonary enlargements. The matter stated that the "empyema" had existed for three days. (Diphtheria was prevalent at the time).

Before leaving of this matter I might here allude shortly to a method of aiding and retaining the expansion of the lung which I have had considerable opportunity of observing at the Liverpool Royal Infirmary Hospital during the past five years. I am aware that the principle has been adopted several times previously, but the practice as I carried out at the above Hospital differs in its details from many of the previously tried methods, and the results which care is taken to maintain asepsis have been highly satisfactory. I refer to the plan introduced among us by Dr. Williams, one of the surgeons. The procedure is as follows:—A carefully purified trocar and cannula (the latter having a bore which just allows a rubber tube, purposely to be prepared, to pass through it) is packed through the intercostal space, and whenever the trocar is withdrawn the thumb, rendered antiseptic, is placed over the orifice of the cannula. Some pus is allowed to escape, the thumb
being replaced over the cannula during each inspiration to ensure that no air enters. A long rubber tube (having a diameter of about 3/4 inch) filled with boric lotion, and taken direct from a bottle of the same is then quickly pushed through the cannula during an inspiration until about two inches of it project into the thoracic cavity. The cannula is then withdrawn, leaving the tube in situ. The free end of the tube is in the meantime retained in a bottle of lotion. An oval metal shield, slightly concave, and having a central projection, surrounded by a collar on its convex side, onto which a piece of rubber tubing is notched, is next slipped over the drainage tube; its concave side towards the thoracic parietes, and when closely apposed (a piece of boric lint or other soft dressing being interposed to prevent pressure) the piece of tubing on the collar is unrolled so as to grip the drainage tube and prevent it slipping out. The shield is then fixed in position with strips of adhesive plaster. The essential part of the apparatus is next affixed to the free extremity of the drainage tube, namely an india rubber stop valve, which allows the escape of fluids from the chest but will neither permit air nor liquids to pass upwards. This is kept saturated in boric lotion for further safety. Every time the patient coughs the pus can be seen to escape freely and the expanding lung is prevented from again retracting by the valvular appendage.

If the tube gets blocked, some warm boric lotion is aspirated back into the chest after removal of the valve.

I can recommend this method of treating empyema, especially
in adults, very highly, provided every attention is given to the details necessary for preventing the entry of any suppurative material and I have seen a good many restored to health with uncontracted chests, within a comparatively short period; But some cases have gone wrong, the pus becoming offensive and unless means can be taken to guard against this, any choice of operation would be in favour of free incision.
(1) Aph. 10: Sect V. "Persons who escape an attack of quinsy, and when the disease is turned upon the lungs, die in seven days; or if they pass there they become affected with empyema" (The Encyclopaedia Botanica - Francis Adams - Sydenham Society 1848-9).

(2) Properties § 7. "A swelling in the hypochondriacal that is hard and painful, is very bad, provided it occupy the whole hypochondriacal but if on either side, it is less dangerous when on the left. But if the fever continue beyond thirty days without any subsidence of the swelling it indicates that empyema is about to take place."

(3) Principles and Practice of Medicine 2nd Ed, Vol I page 195.

(4) Aph. 27: Sect VI. "Those cases of empyema or bursting which are treated by incision on the caudal, if the water or pus flow rapidly at once, certainly prove fatal." (Ben. Botryj Hippol., Adam.

(5) "Ut hinc quidem invicem curantur" (De locis in terminis Sect IV. Referentes. Plur sumin sum it ut in spectaculo in spectaculo coelorum, in spectaculo in spectacula in spectacula in spectacula in spectacula in spectacula in spectacula. From 1190.

(6) "Aqua intercernere laborentes into invenire operari, laborentes conjunctae uxor, expect ore. Aliis in aqua intercurrentia succursus anima frustra sunt nec tenes- sentences aut invenire puro contingantur. Primo sequens as in unius segmentum acutum." (ibid. 3r. invenire vulgatis - ibid. 27 sect 7. ho 4.


(8) Vid. Commentary on above aphorism. - in Ben. Botryj Hippol., Adam. 3r. ho.
1961. f. 37-44. 

(13) Galvani. Méthodes de M. Galvani. Lettres 
écrites de geste phénoménique de la matière 
écrite de geste phénoménique et de la matière 
écrite de geste phénoménique. 

(14) Paulus Regius. Translated by J. S. 

(15) See also La grande liguinie de beauraux. 

(16) Vide a remark by the translator of 

(17) E.g. Tégr de Chauliac - Clémence Angélique. 

Dans les plages dénudées de 
plage, s'il en connait par les signes de la nature 
équilibre dans le calme. 

17 e.g. Tégr de Chauliac - Clémence Angélique. 

Dans les plages dénudées de 
plage, s'il en connait par les signes de la nature 
équilibre dans le calme. 

Conformément au conseil de Salust qu'on est 

caneal : on vient à bout de cette intention, si on met une tige dans
la blessure qui soit fût et avec industrie, c'est-à-dire qu'elles
soit large ouverte par la main qui doit laisser en dehors qu'elle ne
puisse pas tomber en dehors ---- o avant l'introduite c'est-à-dire en la temps,
dans l'office peut, pour faire sortir la surprise ---- ou le blessé
la plus soif qu'autrefois eût que l'excavation de la matière ne se soit pas pris,
forte ---- que cependant il reste une grande pemantou au côté, qu'il est
enflammé en aminance, ou que on ait des signes qui pourraient juger qu'il y
des matières assemblées sur la substitutrice de la plaie, soit que
ces matières pourraient permettre que pour cette et qu'on doit tenter dans des paralysèmes
Guillaume conviendra de faire avec un bistour une nouvelle ouverture dans la
partie superficiale pendante de cette malade. Tantôt vers l'office ----
etre la plus saumante ou entre la truaine et la quintaine ; mais parce
que cette substitutrice de la plaie, dans l'office ou il est
tantât encore en elle ---- à l'office jusqu'aux par de la truaine et qu'elle qui
puisse remporter la sorte de la matière faire errer en dedans
qu'il n'a pas assez pour cette que l'office, et va le même faire
lorsque entre la quintaine et la quintaine qui entre la truaine la quintaine
(113. Il interprètes une erreur) pour cela espérons)

115) Translation to English "ordinance" on the part dans la part
postérieure latérale à quatre ou cinq travers de droite de l'office à
tours des corps n'ayant qu'en sortant ---- page 113.
an evisceration done for a prolonged period by means of tent or cannula. It was noted that cases of penetrating wounds of the chest sometimes get better sooner when allowed to heal early, and it was argued that it might be advantageous to allow the sinus in evisceration to close early also. This view was supported in a very sensible way by Virginius Horstius (and by Fabricius Helvetius in a commentary on his question) who opposed the prolonged keeping patent of all wounds of the chest, without distinction, unless a serious supposition indicated it. But evidence is not wanting that errors were made in the direction of allowing these penetrating wounds to cicatrize too soon; Manchester recorded a case of this description, in which he reopened the scar, and as relieved the evisceration which had formed; but perhaps the most important suggestion in this century connected with Horstius was, which must have argued that since the spontaneous evacuation of the sputum through the mouth was associated in many cases with the entrance of air into the pleural cavity, there could be no harm in allowing air to come into contact with the lung through an external fistula. In this opinion the trochea was the only natural channel of exit for the air, but when this was insufficient, he freely opened the chest between the 2nd and 3rd ribs, employing the plan of making a superficial incision with the potential cavities in the first place and subsequently puncturing this with a knife, thus securing a large aperture which would not be likely to heal quickly. But although Horstius had cases which were successfully treated by this method, and in which no care was taken to exclude the air, he was ahead of his times. His suggestions met with opposition, for instead of less care being taken to prevent its
CHAP. X.

OF PARTICULAR TUMORS AGAINST NATURE.

The Pleurisy is an inflammation of the membranes, involving the ribs, caused by
foul and noxious blood, springing upwards with great violence from the
abdominal cavity into the pleural, and thence into the intercostal veins, and it is
slowly moved forth into the empty spaces of the intercostal muscles, and the
pleural membrane. Being continued through it tends to inflammation in commonly
inflexible parts, causing pain and difficulty of breathing. This impure blood is purged
and accepted one whilst the mouth, the lungs, together with cutting it into the
width, to into the month, the pleural, by unequal, sometimes by food.

But nature being too quick, cannot expedite this purging blood-purging forth insis-
ting the cavity on the chest, the disease is turned into an engery, whereas the cutting
on the ribs is called, who beginning to reckon from below upwards, may make a vpn
between the ribs, and force the blood and its accompaniments either with an
actual operation, or by cutting a large hole drawn upwards, towards the back, but
not downwards, all vessels should be violated which are differentiated under the ribs.
This operation most safely and easily performed by this actual cantery; it is performed with
two holes, through one whereof there is a pin put either lower according to the depth
and nature of your disease, then the point of an iron knife drawn upwards, towards the back,
but not downwards, all vessels should be violated which are differentiated under the
ribs. This operation most safely and easily performed by this actual cantery; it is performed with
two holes, through one whereof there is a pin put either lower according to the depth
and nature of your disease, then the point of an iron knife drawn upwards, towards the back,
but not downwards, all vessels should be violated which are differentiated under the
ribs.

The pleurisy is an inflammation of the membranes, involving the ribs, caused by
foul and noxious blood, springing upwards with great violence from the
abdominal cavity into the pleural, and thence into the intercostal veins, and it is
slowly moved forth into the empty spaces of the intercostal muscles, and the
pleural membrane. Being continued through it tends to inflammation in commonly
inflexible parts, causing pain and difficulty of breathing. This impure blood is purged
and accepted one whilst the mouth, the lungs, together with cutting it into the
width, to into the month, the pleural, by unequal, sometimes by food.

But nature being too quick, cannot expedite this purging blood-purging forth insis-
ting the cavity on the chest, the disease is turned into an engery, whereas the cutting
on the ribs is called, who beginning to reckon from below upwards, may make a vpn
between the ribs, and force the blood and its accompaniments either with an
actual operation, or by cutting a large hole drawn upwards, towards the back, but
not downwards, all vessels should be violated which are differentiated under the ribs.
This operation most safely and easily performed by this actual cantery; it is performed with
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and nature of your disease, then the point of an iron knife drawn upwards, towards the back,
but not downwards, all vessels should be violated which are differentiated under the
ribs.
saei decert, quae callant autorem. *ita sorte perscrueat operatum. in eundem modum, sed formulatae sent. sed causa est, quae antiqui nove reseruam, ut tentantur in partem non autem. denique extant notae, ut ad eundem operatum eundem modo opera, ut in eodem positamentum, quod necesse est donec sciantur, ut ad eundem momentum partes. illum negis in prenstat sup. vel tutissima habe operatum, perficiendi. "Ne quidem tueri non operis in /m the /m."

"Vitamam pecunie pertium extemnem casu, venarum select- asteriorem, nervorum. Miserevorum quae in laceraretur, non in operum, sine tamquam, qui tecum pertium, nec /magis in superioris partes, necque in inferioris partes. Circum inter partem scel- tamque estem perficat, sed adiect in suo septe. pars inferior quintae. S. superiori secundae, itaque nonin vienita sit inferiori parte, non terminis; ad suspensores secundae partem efficiendi secundum, quia per inferiorem partem est, et anatome demonstrat; o Sala. De anat. admodum incursam vicem arterien harmon. ut enim non modo haec partes venitae, sed /magis haec partem properantes quid antiqua non accidet, si aliter quae posse sunt, estem perficat. Nec in inferiori parte /magis admittar hae partes, in intemciata vero extemis estem partem properantes, tumque autem eundem ad eundem secundae parte in qua tuta est perficat, si suo modo, cula incisione una aligavitur, aut denuodatur."

"Ultimo efficiendi secundo est ad utum, l'uncitur modo qua in extem parte? Supponem in superiorem, hanc per sequentur. Partem efficiendi, sciam decedem, inter qua quidem procul positiu, portionem efficiendi est. Ut in collectione aut potius sum, aut aperte, qua cum a florare non licet; sectionem anteriores motus aut alius est quis musculi pectoris sunt; aut terminatur, non quod summum fictum.
quae venas, ubi musculi superponuntur, a plures crassiores, & magis nervosom spinaque propinquiores sit. Reges enim anterius spectant, exanpel quod, quodque aut quinque digiti longa a pectori suo distinct, forma tectum musculi, et partes superponatur prænque non nisi eunum, qui brachium ad pectus adducer, qui eam ubi tentoriam tectum terminum, dolore pellis anterioris quæm posteriori versus pari dabit secem. Alia pateat, quia partes palmarum, uti basi con-}

stinent, tenui vero musculi muscle & nervi, utpote spirantes advent.}

"Itaque sectiones locis qui distant securum anteriori & posteriore sit, ubi}

musculus est vacuus, & abest latitudo. ubi omnis secundaria termini}

sunt, videlicet adductores brachii ad pectoris, obliqui decurrentes}

abdominis, & in seminibus pulnorum est Thoraecum effectus. Externas}

autem venas invenies e plures palmine, unam plerumque a}

medio pectoris ad auctum centum & sexque alteram, hoc est, unam invenis antem ad illa ostre ostre terminum ad opus dimentiarm. Id sequens, quae}

propinquus testis, pars illius secum contra longitudinem."

"Maxime autem in haec operationem invidit secretum, quæ eadem}

restituens vice conversum evict, cum que secundum eorum operis}

vindicat, debilitas tamta succedit ut Hipp. lib. deph. xii. deput. "que}

cunque opera non hydropisierunt aut secuntis, se jam aut quam}

animerum effluxerunt, omnium remittere". Ob quos causam ego}

insinuas ssum cannabum argenteum, quæ ados nigros sit ut}

eacte incidente instrumentum, s foremini respondi, sit ut quantum}

notio liceat quju eamocum non plus se ac ------- facta}

perpuratione, & una cum cannabam, quæ habent alios aut planos appennam,

eat ut intra Thoraecum insinuando non ingrediatur, sed planim

proportionibus percutatur ut posset in omnibus propter opus est. Ex ore collocato

quæ ad suprastum ad eam percutendi, non tamen foliaturas tangit. Curum sit vel

oblique vector incidat, post eam praeter canem cannabem, immittas, electum.
instrument: euritics diaphragma versus nec pulsuum ubi contentur quo

Lusit. 1.  "Sed ministri potestis aliquis ser demi brevem sine

tempore. Ese convulsione rectam sanguem, nec canem ad pene

rit in ea suspense, sanguem diustum eunctione aspera esse detere

numere quem minimum partes espirat: poe plures quidir

fundent. Hinc igitur, quando dubitasse legentur ab hac sanguem

distant aspera esse ebrenit: negato responsum, quia non necessario

eas videtur duas sanguem partes a convulsione defendere,

quando nihil paralysie materie, vel thromborem sanguinem in

cantoris pectoris contentum, quod pluribus demonstrans in cert. pro

tharsis, dec v. quasit. v. Contrarium vero asserit: concedimus tunc temporis

alternae sanguinis, in ipso convulsione Thorecu Elein collectaque, in suis casus

do intraret sanguem dilatae. sced plurum sanguem: sed lemm cura per ingentes

digestia, ab hauriam aliq. endemuntur Brunneae: sequerenda esse pulsuum se.
In loco B (p. 61). "Thrace, therefore, makes a statement which evidently refers to the case of Jason Phereclus— who is reputed to have killed an enquirer which was pronounced incurable. He entered in a combat— seeking his death—but the enquirer's weapon pierced his side, and the matter escaped so that he recovered. "I applaud a quotation from Diögenes Laërtius, 'Translation of Plutarch's ""[of benefit from enemies" (Unrival)."

"For as that instance of Prometheus by running at him with his sword to have killed him broke out the imposthume in his body, and so and thus; in like manner an evil word spoken, sometimes out of anger, or enmity, may cure some ulcers in our manners, which either we knew not of before or else neglected.""

The same history is referred to by Theophrastus, author.

(2) See Helen, Billetis: Quooy T. I. p. 111, "lamento me umbrum petens, proprium claudantium." Also marches, - Observationes medicinae, claviumus harum e. Bog. Observatio de intelli. in vulnera in armis armis penetrante injuriae, perpessam viginti dies obiit. fabrica, obiit corporis marum sum. odi subesta, a suspensa res, praes metu cognata, omnium rem, sancto angelo m. m.

(3) An Account of the Diseases, Natural History, and Medicines of the East Indies—translated from the Latin of Samson Borhome—physician to the Dutch settlement at Batavia—date of dedication in the book 1629. He says, and yet there is no other passage for the discharge of the matter than the harrowing of the body and the matter was further thrown out through the skin, and the body when the matter was discharged entirely, in the course of the circulation, which lay

I will not state or write— I never was so fortunate as never to see such an event— but the method of care I am now to propose though not without slight skill and pretensions, will certainly be acknowledged by every judicious person to be the most
Excellent & effectual preserver; (In the case we commonly suffer to be vended by wine & V. & O.)

(14) The use of these curiously cured by this remedy, among others are, a person
a conjunct in the Dutch part, and then, when I meet them, perfectly assures
me with their kindness and thankful acknowledgments.

(24) Haller. Biblioth. Chirurg. vol i part cc xiv. "In addition to the admixture
suced in paracentesisблилі́ глотку серпі, не в петле ак морінт."
Tab. XXXVII.

Fig. III. - Shows method of making preliminary incision.

Fig. IV. - Incision with guarded knife.

A. Cannula inserted for withdrawing fluid, injected with syringe E.

B. Perforated cannula with clamps for tying. C and D, clamps.

Fig. V. E = knife used for incision, after incision of membranes with sharp pointed knife.

"Histoire de la médecine. Tom. 18. p. 29,

(27) La Vayssosion — Louis d'Opisimo récit par M. Doum à l'Ac. Reutin
par G. de la Vayse 1748. — Douaوصيديé recommend the trochanter for hydro-
hemian. He employed the knife when there was pain. He removed the cavity
but objected to it because it tends to destroy the incision & covering of the ribs —
because it makes too large an aperture that it cannot afterwards close its

(28) Domincque Aneel — L'art de succeder les plaies sans le soin de
la bouche d'un homme 1707. — L'art d'apprêter en peut pratiquer cette
méthode de succès, a du temps et de cet qui penetrent dans la capsa et la
floraison et qui le parait n'est pas d'aucune en partie. — — L'on peut, disons,
a la fin de cette société, qu'il faut introduire dans la plaie en
survivant son trajet, success une certaine le sang repand dans le traje,
mais encore la matière de le sang repand sur la lésion pour
que vide et l'autre partie encore liquides — — — — — Quand on
est convaincu de l'emploi dans les plaies de poitrine par des signes
sensibles, il faut en prévenir l'opération du même nom, en protégrant
le succès de les sucer avec la main de poitrine dont j'ai parlé le
devant.
   "Vestir de la Medecine. Tom. 7. p. 219.

27. La Fage Dionis - cours d'opérations de chirurgie par M. Dionis et M. Revelin.

27a. A. Seck. Opérations e. Expérimens Chirurgica. Leg. de M. Thomas op. and
   Cornelien Postel op. 1692. Expérimens. XXXI p. 113. "La Hydrope Rectoris si fluitum
   facit aqua, simpliciter cne Maiori perforati instituenda. Si vero minus
   fluitum. Major dext. in eum secunda, uta infra in abdomen. Paradisi:
   simpliciter sumus. Halle lignis adstis rectum. notae quae seque
   in loco, quam in abdomen. Colon perforato teperm habitat sperm."

28. Dominique Aniel. - L'art de succéder les plaies sans se servir de la
   louche d'un homme. 1707. "L'essai que en peut pratiquer cette
   méthode de succéder, a des temps d'effet qui pénètrent dans la capitale
   heure et qui le perçoit même d'bout en bout. . . . . . . . . . . . . . . . . .
   on peut, dire, a la fin de cette souche, qu'il faut introduire dans la plaie en
   suivant son trajet, success, un certainement le sang repandu dans l'ouverture
   mais encore la matière et le sang repandu sur le liquide, pour
   peu que l'air et l'outre porc-treliquide. . . . . . . . . . . . . . . . . . . . . . . . . . . .
   quand on
   est convaincu de l'ouverture dans les plaies de portance par des signes
   uniques, il faut en prévoir l'opération du même nom, en pratiquant
   la méthode de les succéder avec la souche de portance dont j'ai parlé le
   devant."
(29) M. Guillaume Mangoust, Série de la Rechle – Traité complet de chirurgie
- Paris 1728.
35. Observatoire médical. Le 21 mai de l'an 1707, la peste fut le soir dater
chez un rabbin de cette ville, pour voir un soldat du Régiment de Berge, qui était
placé d'une espèce de la partie antérieure de la poitrine, entre la cing et la
dixième des mains, les quatre, après de leur avoir assez la tête, qui
neutrat, au dessus de la poitrine, lui causant une oppression si violente
qu'il était près d'opposer. Le vieil était angines de lui, mais refusant
de lui donner les parfums à cause qu'il faut prendre du lait, qui
selon se mesurer les docteurs m'opere que par art magique, auquel
il faut prêter comme à Satan à ces pompes, autrement point
de salut.

wounds should be used to open the interior of the wound from the external one.
At the time of dressing, a clamping dress of hot water should be hold near the wound
in order to keep the air of the wound a quantity of air should not enter the cavity
of the wound in which the dress with a syringe be.

De la cle de la Mette. Traité de chirurgie Tomi page 297.

(31) M. la Mette, Traité de chirurgie Tomi page 257. "La secours pour l'infirmité,
le recommande aux anciens dans les plaies de poitrine, ne voient pas que
leur usage me peut être d'aucun secours."


(33) Samuel Squire. F.R.S. - a critique enquiring into the present state of surgery
1750.
...practitioners seem to have begun to consider other measures for avoiding it; Bastelot, for instance, thought every care should be taken to prevent contact of the lung with the air and that the opening should be steadily closed. At the time of the operation he immediately followed the knife with his finger in order to plug the wound, which was subsequently closed with a tube or a cannula was introduced, which completely filled the wound, which was in turn closed by the same means.

In the modern references to the history of tuberculous it is frequently stated that the use of syringes for the purpose of withdrawing

...in it can find no evidence that Scultetus used syringes for the aspiration of thoracic effusions, although he frequently refers to their use for making injections into the pleural cavity after thoracentesis. At page 237, the third page, he refers in general terms to the use of the syringe both for extracting and injecting fluids, but nowhere can I discover that the chest is specifically mentioned in that connection. Scultetus however mentions the use of the syringe for thoracentesis into the chest, which would not only prevent the lungs staying too quickly, but would also obviate the evil effects of the cold air upon them. These fluids were not evacuated at once but were changed night and morning, a silver cannula being used to withdraw them, which was generally removed after the escape of the liquid unless the original effusion was still in existence.
"Si jani palpers sit atoipti o aequalibus, calor ad extrema corporis usque abiet, nullas amputatio, nulli specem offerat, inibi simila abiet constante, primum necessitatem uterum ejus recognoscam, et tantum tamen esse illa accidit notionem, quae requirantur ad auctorem sanqunies in eosis huius noem am"., etc.


(36) Les opérateurs regardant Gerard method see Cours d'opérations de chirurgie par M. Pierre Berth. Reve. par G. de la Roque. 1740. Footnote page 125. article Dr L'impresse.

(37) Mémoire de l'Académie Royale des Sciences 1740. Dr L'aiguille a manière de la ligature de l'artère inteuctable par M' Berth. This memoire contains an account of the advantages gained by using this instrument over the method of Gerard. The accompanying photograph is taken from the plate attached to internal memoir.
(37) Description of this instrument — by the method
of applying it in the Mémoires de l'Académie
Royal de Chirurgie Tom ii 1814. Vid: —
—Photograph of instrument — copper etched
view attached.

(38) Bellery's mémoire is contained in the
above volume of the Mémoires de l'Académie
Royal de Chirurgie. He also mentions other
methods of arresting ophthalmic hemorrhage.

— Bellery's Instrument —

(39) — Streng — Histoire de la médecine— Tom ii. page 46.


(42) Mémoire de l'Académie de Chirurgie, 1809, Vol. 2, page 50. "Jouand, sur une l proudriée de poitrine, guérir par l'opération. "Je conclus de cette remarque qu'il est nécessaire de ne point écraser à la fois toute l'œuf épanché, et qu'il serait plus facile pendant de ne faire l'ouverture de la poitrine en forme, que après un ou deux jours, pour permettre au poumon un expansion douce et graduelle."

(43) Samuel Sharpe F.R.S. - A Critical Inquiry into The Preceding Surgery 1792.


(46) Vid Coaptus Surgent, Dictionariy 1525. page 1391.


50. *Vid Distémair de Sciences Médicales* page 85.


55. *De la Percussion Médicale et des signes ultimes à l'aide de ce nouveau moyen d'exploration dans les maladies des organes thoracique et abdominale* by P. A. Hesey. Paris 1828.

(61) Javouhey - Huit de la médecine. Tom 78. p. 22.

(62) Médico-Chirurgical Review. 1826.


(64) Ibid. p. 109, 25 sq.


(66) Tulked by Lemoine from Tansay - Précis de la Chirurgie Contemporâne. Paris 1847. Both Schulte and Keyland appear to have invented their instrument in the same year. 1841. Laennec also be described his patients by Jagot at the 1st. Report Bassin, June 23, 1839. to the Académie [17.3.1839].

(67) Pathology and Diagnosis of Diseases of the Chest by C. B. Villainius 1840.


Pochard, Smith - elucidated the aspirators at the Medical Society, in Dublin 1867.

In addition to the above, the following works have been consulted.

Dictionnaire des Sciences Médicales 1872. Article - Empyème - Rallier

- Pleurésie - Chenard
Recherches sur le Phthisie Pulmonaire par J.L. Kayle 1810.


Walsh: "Diseases of the Lungs & Heart" 2nd Ed. 1854. Also 3rd Ed. 1871.

Holtz: "Principles & Practice of Medicine" 1st Ed. 1857. Also 2nd Ed. 1843.

Graves: "Lectures on the Practice of Medicine" 1864.


** 2nd Ed. - page 97.

***
Cunningham's Anatomy - Relations of Pleura
in which case it was sometimes allowed to remain in situ
and was plugged with a cork in the interval between the
injections. The leaden cannula came to have a good
many advocates about this period and appears to have
been prepared chiefly on account of its flexibility—being
easily bent into various curves. They, when writing upon
this subject at the end of the eighteenth century, refer to the
use of the leaden instrument for making its tube adopt itself
to the shape of the wound, a detail which cannot have been
of considerable importance where the tube was worn for
many weeks or even months, as it must have been
at the period of which I am now speaking. In this connexion
there is little else of interest to record in the history
of compurgation in the 17th century beyond the circumstance
that the use of the cantharius for performing the operation
became much lowered as did also the perforation of the
rib or sternum, but it must be noted that Timoni
first made general use of the trocar, inserted between the
third and fourth ribs for the relief of compurgation and by this
Time in 1694, a practice which was supported by
Timoni and Rich (1707)
who stated that he did not see
why it should not be used in thoracic as well as in
abdominal effusions, and be pointed out that the
needles would require to be stronger for thoracic than
for abdominal paracentesis. The danger of wounding
the lung, however, with the needle, especially when
adhesions existed, deterred surgeons from confidently
adopting the use of this instrument and its employment
quickly became abandoned until another century had elaps}
as we shall presently observe.

Almost at the commencement of the eighteenth century, more attention began to be chiefly directed to those effusions of whatever nature which resulted from penetrating wounds of the chest. It is probable indeed that the changes in the opinions of medical men regarding the treatment of intra-thoracic effusions which arose apart from wounds of the viscera, had been greatly due to their observations of these cases; as an important example of the idea of removing fluids from the chest by means of a large syringe may be cited, and it appears to have originated with Arch, who in 1707 invented a machine for pumping out the thoracic cavity through canulae of various shapes and sizes; he was led to this practice through observing that soldiers resorted to it, using only the mouth for withdrawing the fluid (blood) and that recovery frequently followed. This primitive aspiration.

La Harpe 1722.

De la Mütte, who write about this time inferred that it was customary to be accompanied at every chest by a professional "scratcher" (a quick), and that the results of this treatment were sometimes so fortunate that many people attributed them to the devil. He had seen one of these patients after making such a wound simply cover it with a piece of paper, and on the following day the patient—who had been grievously wounded—was able to attend. This affair de la Mütte however disapproved of suction in these cases on account of the danger of increasing the haemorrhage, and in most of his "observations" which I have read, after attempting to get rid of the blood (or in one case blood which
and became prevalent) by making the patient hold his breast or chest, he drew off the effusion with a列入 sound.

Heister was another exponent of this practice of suction, and I only mention him in this connection because he recommended it for the purpose of removing the air contained in the chest, in other words, although he put it in another way, he employed this suction for assisting inspiration after the

This author as well as de la Hôlette pointed out the

importance of making a counter opening low down

in cases where the chest was wound high up and

in which effusion had occurred, and both of them notating

the necessity for having a sausage which had acted held

near to the wound to warm and thus any air which

might be drawn in.1 In cases of empyema

proper Heister preferred to incise the superficial muscles

and afterwards to perforate the pleura with a trocar

whilst de la Hôlette used only the knife, but he was

the first to give up the use of injections in the after

treatment of the cases, attributing to their use some

unfortunate results.2 It was about this time too

that another observation was made, which like the

abandonment of injections by de la Hôlette was

opposed to the teaching of Hippocrates; I refer to the

statement of Brunner who in 1705, remarked that

an ichorous pus did not always necessitate a pleur

sion— a circumstance which has been amply

confirmed by many subsequent writers.

From the above it will be seen that in the class of cases of

which I am now speaking, there were two principal problems.
Before the minds of practitioners generally, the removal of the
effusions whether of blood or otherwise, and the withdrawal
of air from the chest or prevention of its entry, towards
the latter half of this century there were some most important
matters discussed having reference to these consequent
effusions following wounds; some surgeons maintaining that
they should be speedily removed, others holding that it
was best to leave them and to allow of their absorption
or spontaneous evacuation by natural processes. Sharp
for instance opposed active interference strongly, on the
ground that it favoured recurrence of the hemorrage
and that if coagulation had occurred the clot would
be unlikely to escape through the wound; whereas
on the other hand Van Swieten as strongly urged the
removal of the blood whenever the general symptoms
such as return of warmth to the limbs and the strengthening
the pulse) indicated the cessation of the hemorrhage.
If the blood remained in a fluid state, the patient
having been placed conveniently was instructed to
hold his breath to force the blood out, but if clotting
had taken place, aspiration was best recourse to by
means of a syringe; the wound was dilated if need
be, and fluids were injected to assist in the
evacuation by dilatation and breaking down of clots.
Various pumps were recommended to favour these
measures, one invented by Benda was introduced by
Ludwig in 1769. He advised the evacuation of all the fluid
at one time unless the person exhausted with the perform-
ance of the suction was inconvenience by the least.
Empyema and Allied Thoracic Efferences considered Historically, Clinically, Experimentally and Practically.

**History**

In the history of Medicine there are few diseases which have excited more controversy or which have gone through so many phases as regards the methods adopted for their relief as the one which I have chosen as the subject of this essay, and I am prompted to write upon it now partly because during the past ten years a large number of cases have come under my own notice, treated in various ways and with varying results, and in part because even at the present day, it is not infrequently happens that one meets in practice with great diversity of opinion not only with regard to its treatment, but also even respecting its diagnosis.

The term Empyema (ἐμπύημα) appears to have been used by the ancients to designate an internal collection of pus, whether in the pleural cavity or not, and the first restriction of its use to thoracic cases has been ascribed to Aëtius, but it has to be observed that in reading the older continental literature of the subject an effusion of serum or of blood into the chest is not infrequently attended to under this name.

The credit of describing the symptoms and nature of empyema is generally ascribed to Hippocrates who makes frequent mention of it in his writings, and it is fully described in some of the books of the Hippocratic school which are more doubtfully the direct product of his pen; Hippocrates however probably inherited some of his knowledge of this, in common with other diseases, from his...
disagreeable odour; another similar instrument was supplied in 1770 by Leber, simpler in construction and not requiring the application of the mouth, but Richter pointed out that these appliances were not practicable, because if the blood remained fluid it would escape by itself through the wound, and if clotted it could not be pumped out.

It was at about this period, and probably in relation to these discussions, that surgeons began first to direct their attention to the prevention of these effusions of blood, by appliances of various kinds to the injured intercostal vessels. The earliest of these consisted of ligatures—placed round the rib by means of curved needles. Soon after 1740, appenzell introduced this method. He employed a curved needle furnished with a thread, to which was attached a pledge. The needle having been passed round the rib and put above its superior border, the thread was pulled upon until the pledge attached to its superior extremity pressed against the inner surface of the rib, when the thread was tied over a thick external compress. Somewhat later Bouvard improved upon Leber's method, by making use of a needle having a handle. The curve of the needle was such that—when inserted at the upper border of the rib—the handle pointing downward—it was made to encroach the inner costal surface, so that at its lower border, by simply raising the handle, the thread was then pressed and the needle withdrawn by again depressing its handle. To the inferior extremity of the thread a large pledge was then attached—a little incision being made to allow its entry, it was drawn
into practice by pulling upon the other end of the thread, which was fast to a compress. Both Gerard and Lintot incised the skin before inserting the needle, the advantage claimed for the needle being a handle was that it involved less risk of winding the lung or pleura. Another method of arresting intestinal hemorrhage proposed by Lintot was to insert in the intestinal wound of an open stuffed instrument, bent at one end, having a post attached which was applied against the inner surface of the rift, the free extremity of the instrument being pressed down by a bandage round the chest. Leucy supposed made use of a counter, pierced with holes to which threads were attached, and which being drawn upon after the counter had been slipped into the chest caused compression of the vessel; these Belloo invented a special tourniquet consisting of two plates or blades which could be brought together after introduction of one of them into the chest. These various methods or the simple application of astringents were relied upon with little modification until early in the 19th century when Lacerini (1812) expressed his opinion that the best way of stopping the hemorrhage was to complete the section of the vessel, and trust to its retraction rather than from the risk of doing harm by the introduction of instruments of compression. I have thought it right to speak of these traumatic cases because they not uncommonly occur in suffocation, and their treatment might be regarded as preventive of suffocation. The other point which have received renewed attention at this time, was the admission or expulsion of air from the chest after operations for thoracic effusion; it was Henry Bass who, about the year
1717 first made the attempt to exclude air by means of a lateral opening — which he effected by making the entrance incision at a different level from that in the pleura — so that after the evacuation of the fluid, the orifice might be closed by relaxation of the skin; a practice which has since its advocates until a comparatively recent date. (Sir Astley Cooper, R. S. W. 1875. Gravina, surgery ed 1745.) Luske in 1765 improved upon this method by again making use of the breast, and by placing the finger in the orifice of the canula during each inspiration so that air could not be drawn into the chest. But although this appeared to be a great advance, and must have been successful in some cases of hydrothorax, its obvious disadvantages in emphysema evidently became apparent, for we find Cleopart and Dusart ten years later abandoning its use and resuming again its simple suction, and in 1778, Heumann expressing the opinion that it was useless to take precautions for the inclusion of air. I have mentioned incidentally, when speaking of the suction of wounds, that Heister suggested it as a means of withdrawing air from the thoracic cavity, and that the spoke of making the patient take a deep breath as an alternative. This method of forcing expansion of the lung, or as it was then designated, of expelling the air, was also practiced by Van Swieten, who regarded it of great importance, but he admitted the impossibility of preventing the admission and retention of air, so long as any fluid remained, and only endeavored to expel it when the cavity had become empty of liquid; then holding the lips of the wound together with two fingers, he made the patient take a deep breath — opened the wound and closed
it again before operation took place—and having repeated the process several times, the knife was at length sealed with striking plaster, which was renewed as seldom as possible. Another point of interest in this connection, because it indicates that the need for proper expansion of the lung may have been recognized as far back as 1759, before the minds of these practitioners, was the advice of Kornell, who considered that the effusion should be partially withdrawn once or twice at intervals with a trocar before the chest was finally opened, in order that the lung might become accustomed to its enlargement, and the diaphragm resume its archetypal condition. The treatment of adhesions, complicating thoracic effusions, commanded some attention during the latter part of this century and commencement of the next; some surgeons advocating their destruction with the finger or the sound; others regarding this as likely to do harm to the lung, and preferring either to divide them with the knife or to leave them alone (clipeus or spaces), but if when operating on a seat of effusion it was found that an adhesion was come down upon, and that the fluid was sucked in this way, it was by several recommended that the incision be prolonged, or failing this that the operation be repeated in another situation.

It must not be supposed that because the various treatments which I have mentioned were employed up to this time, that the disease was considered simple or that it was always easy of recognition; on the contrary, the histories of the cases which I have read in the writings of surgeons during the 18th and early part of the 19th centuries only too clearly show that the diagnosis was often missed altogether, and that the
Syphilis required to be very pronounced to allow of its being with certainty recognized. It may be interesting if I mention the opinions of some of the men of those times, which will indicate what have just observed.

Samuel Sharpe, M.D., Surgeon to Guy's Hospital in 1780, considered that the species of leucopneumon, where the lungs adhered to the pleura, so that the fluid produced an external swelling, was most common and that the true leucopneumon (which he thought to be due to the bursting of an abscess into the thorax) was rare. He believed that operation was generally needless because of the tendency for the lungs to cast off the matter in their substance or in their surface, but he thought there were some abscesses not only of the pleura and mediastinum, but of the lungs themselves which proved fatal for want of a discharge, or if some of the matter became carried off by the trachea, the lodgment of the remainder produced the same fatal result. He therefore regarded it as important that the few cases requiring operation should be clearly recognized, and of all the classic signs (e.g. dilated side, desaturation, absence of pain) as named by every author) be placed greatest reliance upon the spontaneous expansion of the side of the chest.

Joseph Warren, who was contemporaneous with Sharpe at Guy's Hospital, records three very striking cases treated by squirting which were subsequently kept open with pins. One of these was fatal, the diaphragm having slipped through so that the liver was free, but the other two were cured, one in six and the other in five weeks after being operated upon. These cases illustrate the point that the disease, in less time, was generally far advanced before being recognized. The fatal one was under
observation — and was repeatedly bled, to relieve pain and dyspnea, for several months before it was indeed; the second case took
became an enigma of necessity, and the remaining one,
a man of 27, who had been ill for three weeks before his admission to hospital, was not known to have enigma until
he had been in the wards for about three weeks. In his
annihilation in these cases, Lépine remarks that he considers
immediate operation imperative, and that ‘it should not be
deferrable in expectation of the fluid being absorbed into the
circulation, and evacuated by the urine, shock or spitting—that
cases of success by these means are rare and that death frequently
results by putting off the operation too long. It is interesting to
note that this surgeon, after opening the chest in each of his
cases, introduced his fingers into the pleural cavity to seek
for adherences — and I have no doubt that their absence,
which was recorded in every instance, was regarded as
a favourable prognostic for the patient. That Lépine, who was a
great authority at the time, and is generally quoted by authors
of the period, says in this chapter an enigma that (enigma of)
which proceeds from a enigma in the chest may be cured
by an operation of the lungs do not adhere to the pleura, but
if they do, and if the pus which was enclosed in a cavity,
happens to be diffused upon the skin, then there is very
little to be done in such a case”. Lépine describing of the
physical and vital signs of the disease do not differ materially
from that commented by other writers but in naming the
difficulty of lying on the sound side, he remarks that although
this is a positive symptom, its absence does not prove that there
is no effusion, since when there is collection of the lung.
with the increase in the amount of liquid, spread.

Hegy in 1803 recorded an interesting case illustrating the fact that recovery may ensue when the chest contains enormous quantities of pus. Five and a half pints were evacuated and the patient afterwards wore a slender cannula for fifteen weeks, and eventually became quite well. Hegy regarded the ejection of the affected side an important symptom; in this case (which by the way resulted from influenza rather prevalent) it continued to the face and shoulder.

Charles Bell (1807) after detaching the usual symptoms, refers to the peculiarity of causing at a spot where the matter is pointing, or failing this at some place where there has been a long continued, fixed pain, and in the absence of either of these indications, between the 6th and 7th ribs. Bell states that the discharge continues long, unless the constitution is poor and the collection local. Patients often died; he also points out that when matter has been concentrated the cavity of the chest is diminished and the diaphragm rises very high. In one such case a post mortem showed that had the opening been in the 6th interspace, he would have entered the peritoneal cavity, the need use of a thorax. After detaching the intercostal cannula, in order to satisfy himself as to the nature of the fluid, if it proved to be serous, the cannula was allowed to remain until the fluid had drained away, after which it was removed and the skin allowed to retract over the wound, but if purulent the pleura was incised.

Up to the year 1808 the custom which had existed since the days of Hippocrates of allowing all kinds of chronic effects to enlarge a little at a time, had remained in force. There were surgeons
who made occasional complaints to this, as well as to their practice, but
the symptoms remained unaltered; at this state however, Bonaparte
asserted that their continued withdrawal of large quantities of fluid was
not liable to be followed by such harassing results as was commonly
thought, and he had seen a case in which there had been a
considerable collection quickly restored to health after having all
the fluid withdrawn at one time. This is a very full and interesting
record illustrating this point (although the patient eventually died) in
Bonaparte's memoirs, de la chirurgie militaire (1812), that of a young
soldier—named des charmes de la garde—who after an attack of
pleurisy (April 1810) complained for some time of a pain in a particular
part of the side, which he underwent violent exercise, associated
with shortness of breath, palpitation, and gradually increasing
weakness, on account of threatening suppuration he again entered
the hospital in May 1814. His left chest was found to contain
pus, which escaped out to a distance of more than four feet
in the intercostal space being incised. It was all allowed
to escape, and the amount was estimated at from four to
five litres. The operation was followed by no symptoms of other
ill effects, on the contrary there was great relief to the suffering
dieters and the contractions of the heart appeared to take place
more easily. After having an activity for some weeks, he
was one day suddenly seized with rigor, shiver, oppression, difficulty
of respiration, and colic, the result of exposure to cold, having been
another observation made by this author is worthy of notice—Knowing that in cases
of typhus the pleurae are in a dehydrated condition, he considered
that the absence of air after operation was likely to be rather beneficial than
otherwise, and on account of its tonic effect, it would stimulate the absent
powers of the pleura and penetrate the peritoneal of these organs adhering between the
twisted and twisted peritoneal strands, which adhere in partition cases, obstructing the cavity.
This incision was not favorably received or commented upon by subsequent authorities.
They alleged admitting the possibility of absolutely preventing the entrance of any other fluid
that it was very probable that its success should be as limited as possible, and that what had first begun into
the chest cavity should be worked up as regards its temperature, elasticity. Bonaparte wrote this progress
and year of its, which took place during the early days after the operation "expiration illogitrate."
found uncovered on a very stormy night, and in spite of vigorous treatment he afterwards rapidly recovered—until lacert— and died on July 31st 1804. Larrey regarded it as important to prevent contact of the air with membranes accustomed to the presence of a liquid but considered injections to be rarely useful, and as tending rather to irritate the organic capillaries formed in the pleura, by their mechanical action. He did not use lacert, and dressed his incision with a simple compress, after inserting a strip of lint into the wound. He regarded these cases as likely to be of long duration, and very difficult to heal.

But another and greater interest is attached to the case which I have just related in that it brings to our notice the fact that at this period displacements of the heart, the results of left-sided pleuritis effusions were probably only beginning to be clearly recognized and that the value of this sign for diagnostic purposes was as yet uncertain. This patient was in the first place attended at the medical wards under M. de Laborde, who calmly recognized that the heart was resting on the right side, and the inference that it had become dislocated from its ordinary situation by a traumatic cause. The man having stated that he had received a blow from a stone in the right side of the chest, at the siege of Saint-Jean d'Arc, the pulsations of the radial arteries were very feeble, whilst those of the heart seemed very strong, being directly transmitted to the chest wall, and the doctor considered that this transmission by constraining the heart's action, was disturbing the circulation. The case on account of this displacement of the heart excited much curiosity among the patients and many of the practicalness in the town. and it was not until Larrey recognized that there was thoracic effusion on the left side that the nature of the
ancestors, the Asklepiads, who presided over the Temples of Health in Greece, and who are the accredited authors of the first book of Monographs and of the 'Canons' of which, according to Dr. Adams and some other authorities, together formed the basis of the 'Monographs' of Hippocrates, containing so excellent an account of the means of recognizing this disease, which may therefore be regarded as one of the oldest known to medicine. As examples of other suppurations which were called 'Empyema' by Hippocrates, Dr. Adams might be cited, where a purulent exudation from the chest resulting from collection of a discharge of the lymph to the lungs is probably alluded to. In the 'Monographs' (pap. 40) the Empyema spoken of seems to refer to a suppuration in one or other hypochondriums, and many other references might be given to show that pleurisy and empyema were also included in this term. But that Hippocrates was well acquainted with this disease as we know it is abundantly proved by the descriptions which he gives both of its clinical features and of its treatment. It is commonly thought that he was accustomed to rely greatly upon suspicion for arriving at a diagnosis of this condition, in other words, that he recognized it chiefly when associated with pneumonia. In his description of pneumonia, Dr. W. J. F. S. p. 93, in a footnote making reference to a quotation from Dr. Storrie, remarks that the Hippocratic pathology of Empyema consisted in the building up of an abscess into the pleura as the result of pneumonia. That Hippocrates associated empyema with pneumonia there is no doubt, but it is equally certain that he was able to tell when a chest contained pus without the advice of any gaseous material; this we learn by his description of the means of arriving at a diagnosis, which is so excellent that I venture to quote it in its entirety from Dr. Adams,
condition appears to have been understood. After the opening of the chest, the heart in this case did not return to its normal position, but was still beating to the right of the sternum in the 13th day, and at the post mortem examination it was found to be so bound over by adhesions that it was difficult to move it and to the right. The left pulmonary artery was almost obliterated, the aorta had been displaced and the vessels arising from it, especially the innominate, were very much the walls of the latter being almost in contact — all these conditions were held to account for the diminished peripheral pulsations both before and after the operation. The post mortem report states that there was also a patent pericardial cavity and absence of pleura.

In addition to this being an absolutely collapsed lung, it was further discovered that the sternal costal junctions of the 7th and 8th ribs were carious — notably the result of the blow from the stone before mentioned — and in this was attributed the pain complained of before his admission into the hospital for the second time as well as the hemorrhage itself. I regret to see mention of contraction having taken place in the side in this case although I refer to this subject in my "treatise."

The displacement of the heart is noticed by most authors since the year in which the above was narrated, but in the books of antecedent date to which I have been able to refer, I can find no mention of it, from which I judge that it must have been just observed about this period. It was however only noticed as occurring in left sided effusions until about the year 1833, when I A. T. B. pointed out that there was cardiac displacement to the left in cases where the disease was in the right side of the chest, and he speaks of these indications, since they seldom arise from any other cause as being "the most constant and best criterion of all the signs of effusion." Prior to this time...
The cardiac displacement was often of so long standing as to make it rather occasional in occurrence even when the emphysema was on the left side; Cooper mentions it in this way, and comments upon a post-mortem which he saw at St. Bartholomew's Hospital—where there was a large left emphysema in which the heart had been reduced pulsating to the right of the sternum, but the diagnosis had been missed, and some had thought it was a case of some unusual mistake which was not without precedent, for T. Coxe in 1804 described that in emphysema the movements of the heart and thoracic vessels frequently gave rise to some mention of displacement but some of the cases referred to were probably instances in which pulsations were transmitted to these localised bulgings occurring in emphysema pointing externally (pulsating emphysema of Tocquet). Such a case is mentioned in the Dictionary of Science, where in the left side posteriorly there was a swelling having all the appearances of an aneurism due to the pulsations being transmitted through the chest.

The transmitted pulsation observed occasionally in the intercostal spaces when the chest is full of pus was first described by Greenaw, and it must not be confounded with the fluctuation in the spaces, which together with a sense of resistance had been relied on as confirming signs for some time previously, although Thomson has claimed to the credit of first having discovered the former. He discovered this sign accidentally, when observing with the pleurometer and hammer—the impulse being transmitted each time he struck the pleurometer to the lymphatic eminence of the hand holding it, which was resting on the chest wall. He afterwards practised it by placing the palmar surface of the index finger in the intercostal interval.
be presumed. In 1813, Bichat endeavored to establish an aide to diagnosis by means of abdominal pressure; he thought that by pressing upward from the hypochondria region a sense of suffocation would be produced when the side containing the pus was compressed, but the value of this method was never confirmed by experience, since it was found that many healthy persons suffered respiratory discomfort when it was practiced upon them, and that in cases of disease, pressure on the sound side produced as much suffocation as did that on the affected one, owing to its causing interference with the function of the lung which was long rent of the body.

The peculiarity of the discovery of Rokitansky (1793) (130) which took place about this period (1809) had a very different bearing upon the diagnosis of thoracic effusions, for it really became evident that it might afford a means of telling not only that fluid was present, but also the height to which it reached; in fact, it was the first clinical method which had thus far existed whereby the presence of effusions in their earlier stages might be recognized.

It distinguished liquid from other causes of dulness. The patient was examined in various postures (such as we now consider a case of aneurysm) and by leaning to where the dulness did or did not appear from a dependent part; when this was made superior in position. It is not surprising therefore that we find it stated that the results of percussion were often untrustworthy and had proved fallacious on many occasions when we consider that the levels of pleural effusions often fail to be affected by changes of bodily posture, even when they are moderate in amount.
and it would therefore seem in the presence of some of the other, then known signs, have been often impossible to say whether the dulness was due to fluid or not. Hence, although a great advance was made by the recognition of this dulness in percussion, which is at the present day perhaps the most reliable of the cardinal signs of thoracic effusion, its full value did not become manifest until Laennec made known the greatest of all the discoveries relative to the diagnosis of thoracic diseases. The combination of which with percussion has enabled practitioners since then to make these more refined examinations. By means of which, at the present day, we are able not only to say with precision that there is an effusion, but also to estimate its extent or its gradual increase or decrease, with comparative exactness. It is right that we should mention here that Jevkington contributed much to this instrument when he introduced Sédilicius percussion by means of auditory plummet in 1828. Prior to this time no plummet was used for this purpose, being simply struck with the end of the finger or sometimes with the flat of the fingers. Piercy's modification of Corvisarti's method greatly enlarged the field of physical diagnosis, and afforded a means whereby the anatomical limit of organs, both normal and abnormal, as well as pathological effusion might be determined. The motto on the title page of his book is "un organ imitant d'autrui, cherche à déterminer pendant la vie son disposition physique." When we consider the more limited utility of immediate percussion, I think Laennec's observation which I quote from
The introduction to this work might well have been deferred until medical opinion had been established; the sage (type 3, Italian translation) "May I dwell so far as to assert, without fear of contradiction from those who have been long accustomed to mortal disease, that before the discovery of auscultation, the bulk of the cases of peripneumony and pleurisy, and almost all the chronic pleurisies, were mistaken by practitioners"; yet I do not think we can assert that the accuracy of diagnosis has become very much more assured until I have added this own discovery to the are alone referred to, and it cannot be said that much advance in the physical diagnosis of congestion and other intra-thoracic affections has been made since he published his work. His discoveries were made (1816-1818) to which I refer the reader for a detailed account of the additions which he made to previous knowledge of the signs of these diseases, for since they are practicallyunknown at the present day and are known to every physician, it is hardly necessary that they should be more than mentioned in this essay. Shortly capitulated they are as follow:

1. The rapid increase of the dulness on percussion (dullness making from peripneumony).

2. The intensity of the dulness on percussion is as great when the breath sounds are audible as when they are absent.

3. The diminution or absence of the respiratory sounds. Their condensation where adhesions exist, and the frequent bronchial character of the breath sounds.

4. The peculiar breathing on the sound side (in chronic cases) and its occasional extension to the diseased one.
5. The frequent, long duration of the indications of the repositioning sounds and of the dilatation in percussion, after the absorption has taken place, due to the presence of false membranes.

6. The appearance, disappearance and return of physiognomy.

Its limitation to moderate effusions and its value as a diagnostic of the presence and amount of the effusion. That its return after disappearance or absence indicates that absorption is taking place, and its long continuance is indicative that the effusion is not increasing.

7. The signs of diminishing effusion (disappearance of the bell sound from above downward, and of the physiognomy 20).

8. The precise description of the contrasted sheet following absorption of the fluid. *"
as long compressed had lost its elasticity, and could not expand to its normal extent, so that the long continued suffocation gradually undermined the patient. Lacerum did not\footnote{This principle was again suggested by her Friend of Rotterdam in the Medico-Chirurgical Review for 1826. He relates the case of a girl in whom he allowed the wound to close by the 5th day, with the result that such air was included which he thought had been sucked into the pleural cavity through the wound. (It was more probably derived from a bronchial fistula, for the patient expectorated pus). The suffocation again pointed and lasted at the least of incision on the 23rd day, after which the patient gradually recovered. She closed at first being much contracted, and the spinal column curved, but eventually this improved and was much less perceptible six months later. Her Friend attributed much of the danger of} remain without the thinner because the chest refilled after withdrawal of the fluid, although he thought it might be dangerous in the acute empyema (not necessarily pointed). He preferred thoracocentesis and percutanous that early operation would probably become preferable as the pleuritis became recognized sooner, owing to the expansibility of the lung being less interposed with, and it is interesting to note that he suggested the use of an emulsion of eau-de-joufflant over the wound after excision of the fluid to cause a reseverence in the chest cavity and thereby aid expansion of the lung, an idea which had never been thought of previously by an anonymous French writer (quoted by Lacroix) who advised the application each day of cotton gauze over the wound— a proceeding which was repudiated by Severinus (Dr. Of course medicina Salutis) 1668) on account of its cruelly.

\footnote{This principle was again suggested by her Friend of Rotterdam in the Medico-Chirurgical Review for 1826. He relates the case of a girl in whom he allowed the wound to close by the 5th day, with the result that such air was included which he thought had been sucked into the pleural cavity through the wound. (It was more probably derived from a bronchial fistula, for the patient expectorated pus). The suffocation again pointed and lasted at the least of incision on the 23rd day, after which the patient gradually recovered. She closed at first being much contracted, and the spinal column curved, but eventually this improved and was much less perceptible six months later. Her Friend attributed much of the danger of}
Nevertheless to the entrance of air, and thought it necessary to exclude it because it simply sublimated a vapour for a liquid compress, and because it gave rise to decomposition, (which in turn was another source of gangrene accumulation).

On these accounts he suggested as a substitute for suction, the introduction of a small tourniquet to the canula of which he would attach a tube connected with a closed vessel; and, though this he proposed to withdraw the Jews, subsequently removing the canula without detaching the tube, and then applying the wound with flannels and a compress, to prevent it being forced open by anything. I have not been able to discover that this Tourniquet plan was ever acted upon, although it was probably the nearest approach to true suction which had then far been proposed. During the fifteen years which succeeded the publication of Linné's work, his methods of diagnosis gradually gained the confidence of the profession, although some time elapsed before practitioners relied on them rather than upon the older signs. In the descriptions published in the various medical works of the period, it is noticeable that at first the disease was very often recognized before the stitches were employed, and that it was then read as an additional means of diagnosis, and so at length its use in this way became confirming of its own utility. Some books, more especially the surgical ones make no mention of auscultation as an aid to diagnosis. For instance Cooper's Surgical Dictionary, a classic proof, describes all the older signs of the disease, including percussion, but omits the atheromatous signs, and states that the symptoms altogether are very equivocal and the constitutional (i.e. the change) of the disease immensely doubtful.

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Indirect writers, however, generally deduced them. I have quoted authorities to refer to vocal phenomena in its historical relations, owing to the fact that although it was known to LæDescr. (having been described in 1817 by Reyman) he did not esteem it a reliable sign, and the few occasions made of it even by the best writers after his time, some Hudson independently directed attention to its value in this country, his observations being published in 1833 by Thomas Dollis, and since then it has always been regarded negatively as one of the cardinal signs of the disease. (1)

I give in due the credit of asserting that the intercostal muscles and the dilatation become distinct, not on account of the pressure to which they are subjected by the accumulated fluid, as because they became paralyzed owing to their inflammatory action, much in the same way that a tooth, when it becomes distended when inflamed, and in support of this view, the object attention not only to the fact, that the muscle act of the absorption of the fluid, but also to the circumstance that non-inflammatory conditions causing distension of the chest, such as hydrophobia) causes the pleurisy, enlargement of the liver, the not cause flattening and loss of tone of the intercostal muscles, and finally the point is in further proof of the paralytic nature of this phenomenon the circumstance that in some cases of pleurisy the dilatation of the thorax is generally up to a certain point, suddenly yields, without any increase in the amount of fluid escaped. He noticed that protrusion of the intercostal spaces was a sure sign of the persistent nature of an effusion - an observation which has the subject of many modern writers, although it was denied by Walsh. Others also directed attention in this connection to the
displacement of the liver which he had observed in 1822, and
the related deformity of the spleen, of which he had had personal
experience; but he was by no means the first to observe these
haptic displacements, for they had been previously described, but
had nevertheless been frequently mistaken for enlargement of that
organ, as exemplified in a quotation by Sumner from a likewise
by hom, relating a case pronounced as an incurable enlargement
of the liver, which proved to be a deformation of that viscus suffering
when paracentesis was performed by Bidot. Copland (next dist-
cur, Liverpool Hosp. 1833) considered that the liver was frequently
collapsed in congestion apart from any displacement—an doctrine
which he claims to have made so early as 1818— owing to its under-
taking a reasonably increased pressure to remove stagnation from the
blood which would accumulate on account of the impaired action
of the lungs; and he also points out that it is frequently compressed
and thereby still further enlarged in the more chronic cases
of congestion, owing to the circulation in the lungs being
interpreted and thereby causing backward pressure. There
here mention that the difficulty which sometimes existed in
distinguishing an enlarged liver from a right-sided congestion
was known to writers of the 17th, 18th centuries, and not a few
cases of absence of the liver had been operated upon in mistake
for this disease (e.g. Dean, Bernard, etc.).
Here remains one physical sign, and one clinical method
so mention in the historical part of this essaynamely, the
Symmetrical resonance heard in moderate oppression, or percussive
underneath the clavicle, which was pointed out by Hulo about
1850. It is highly useful as a confirmatory sign although not
always absent in pneumonia. The method to control I presen...
Translation of the "Proprietary" (paragraph 117, p. 3).

"Propriety 9th. "One should estimate when the commencement of the
suffocation will take place by calculating from the day on which
the patient was seized with the fever, or if he had a piper, and
if he says that there is a weight in the place where he had
pain formerly, for these symptoms occur in the commencement of
suffocations. One then may expect the suffocation of the
pleasure to take place from these times according to the periods
formerly stated. But if the suffocation be only on one side,
or should turn him and enquire if he has pain on the other
side, and if the one side be better than the other, and when
laid upon the sound side, one should enquire if he has the
feeling of a weight hanging from above, for if so the suffocation
will be upon the opposite side to that on which the weight
was felt."

"Propriety 17th. "In the first place, the fever does not go off, but is
always during the day, and increases at night, and excretes its
effect at times. There is a desire to cough, and the patient expels
nothing worth mentioning, the eyes become hollow, the cheeks
have red spots on them, the nails of the hands are bent, the
fingers are hot especially their extensoria, there are swellings
in the foot. They have no desire for food, and small blisters
(phlegmosene) occur over the body. These symptoms attend
chronic suffocation and may be much trusted to, and such
as are of short standing are indicated by the same. Provided
they be accompanied by these signs which occur at the
commencement and if at the same time the patient has some
difficulty of breathing. Whether they will break earlier or
later may be determined by these symptoms, if there be pain,
was the employment of the grooved needle for puncturing the
thrust as a means of distinguishing between serous and serpulcent
effusions, it was introduced by Dr. Thomas Davies in 1845;
and was generally employed until supplanted by
the hypodermic needle, first recommended for this purpose
by Czerny.

As regards treatment: 

1. The practice published by Marcier,
advocating the performance of punctures in all cases of
considerable effusion (1843) and (1858) the universal
practice was to treat by bleeding, for the purpose of arresting
the causal inflammation, and to diminish the amount of fluid
passing through the compressed lung. Local remedies were
employed in the shape of cataplasmes and (after the subsidence
of the fever) blisters or the application of the moist. Internally,
it was customary to give mercury and iodide of potassium,
diuretics and low diet (a quotation from Bretonnias being
sometimes added to "The more a patient eats, the sooner will he
die.") All of these remedies were intended to help the venous
system as simply as possible, in order to render it likely to
abduct the effused liquid. By these means simple effusions
were expected to subside, and States considered that most
cases which came to require operative interference resulted
from some error in treatment at an early stage of the
disease, at least, to say, "It is certain that in every instance
with which I have been acquainted, the disease was either
wholly overlooked in the commencement, or improperly and
insufficiently treated."

Up to this time (1843), operations, whether performed with the finger
or by incision, were regarded as a dernier resort, never taken.
had recourse to render the life of the patient secure. Thence, and even when known to be preventable, derivate remedies were by many employed for long before the operation was ventured upon. The principal fear in connection with the removal of a stercoraceous mass to have been that the entrance of air might convert it into a fermentant one, or that it would by its retention keep up the compression of the lung, circumstances which led to the suggestion that thoracentesis should be performed under water. Dr. Smith's invention of a small trough filled with a saline, which could be applied to the cannula after withdraw of the trocar, and Dr. Reynolds' simpler idea (1847) of making a valvular opening in the cannula with a piece of moistened gold beaten skin. In cases already fermentant most of the best writers agreed with Lenners's dictum that thoracentesis was preferable to the use of the trocar, and that it was best to let out all the pus at once, providing a free aperture for drainage, and one might mention here that once again in 1847, preparation of a pel was removed with success by Reynolds, with the object of affording a rapid support for the cannula which he inserted through the hole and retained it there as a draining tube.

Dr. C. T. B. Williams (Path. & Diagnostic of Dis. of the Chest, 2nd Edn. 1850) recommended rejected tapping of the chest in surgery, and also the displacement of the pus with water, which he injected through a double tubed cannula, his idea being that the water would take a more effusion be capable of absorption, but if the rejected tapping the matter still continued to form, the employed weak solution of nitrate of silver or of chloride of sodium.
Some mention is made of cholericum solutions, especially where the discharge had become fetid, and Irenseaeus was particularly fond of injecting this latter under similar circum-
stances.

As already stated, Irenseaeus in 1602 announced his belief in the removal of serious
offences with the trocar in the postnatal, contrary to
the teachings of Louis (who regarded them as never fatal). They
were liable per se to cause death. In his lectures
(Sept.Sec.1817) he furnishes an additional reason for this
practice in the fact that severity offered as the result
of inflammation of the plauren is likely to undergo a transition
into postfetid the latter secretion is likely to be fetid both as
the latter secretion of a postnatal cuticle is fetid). In this
account, he urged operation in cases where there was recent
offense. Irenseaeus certainly did much to forward
the successful treatment of similar offences, but it should
be remembered that he continued upon former methods of
treating empyema for which he also employed the trocar; he
recognized that in children the cases were more likely to be
successful than in adults, and he relates as a fortunate
example the case of Edna Belge, who was tapped three times
between the end of January and August 15th 1853, and in the
last occasion a locally heated ball meant with gas was inserted
in a cannula having a metallic stopper which could be removed
at will when left in, and Irenseaeus solution injected each day.
This treatment was continued for ten months when a bronchial
pulmonary fistula formed, and chlorine water, eventually arsenical
wine was substituted for the iodine. The cannula was
finally withdrawn in July 1854, after having been worn
for eleven months, and eighteen months from the commencement of the disease; more than two hundred injections of iodine and as many of chlorinated and aromatic solutions having been administered.

Since the time of Florence the circumstances which have chiefly contributed to modify and improve the treatment of chronic effusions have been the introduction of the aspirator (of which Dr. Fairfield Smith and Dr. Byas claim to be the inventors) and of the antiseptic system of surgery. The former instrument—in some of its improved forms—has almost entirely superseded all previous methods of treating chronic effusions; whereas the latter system has been responsible for most of the changes which have taken place regarding the treatment of suppuration in the past twenty years. It would be out of place to enter into any detailed description of the many special operations and appliances which have been employed during this period, but the principle of providing free drainage, combined with aspiration has been at the foundation of the most important of them. As a result of the introduction of antiseptics or of the principles which the system involves, every method which does not allow of free and continuous drainage has been abandoned, and the free incision, drainage tube and antiseptic precautions employed of late years have so greatly reduced the mortality from this disease, shortened its course and rendered it less severe.
Clinical Features

Effusion, excepting perhaps in some very acute cases, is to be regarded rather as a complication of other diseases than as a primary condition. It cannot be separated clinically from inflammatory conditions of the pleura, whether acute or chronic and whether the effusion be in the first place serous or not. Therefore in describing the clinical features of this disease, it will be necessary to refer to pleuritis and to the physical signs which are common to pleurisy as well as to purulent effusions. There is reason for believing that most inflammatory effusions into the thorax are in the first place serous in character, and that the transition into pus (when this occurs) takes place with greater or less rapidity according to the nature of the inflammation (serous, suppurative). Some cases becoming almost immediately purulent. Thus constituting the acute empyema, others remaining for long in a serous condition and the transition taking place more or less gradually. It may be as the result of some accidental cause. Hence, although the division of this disease into the acute and chronic varieties may be somewhat artificial, it is convenient for purposes of description.

The symptoms of an acute empyema are simply those of acute pleurisy with effusion. It consists in first the primary suppurative pleurisy, but the degree of aceteness varies, and considerable lubitude
must be allowed in the definition. In a large number of cases it succeeds pneumonia, which having terminated by a crisis—in which frequently the temperature does not quite reach the normal line—there is succeeding this an irregular fever, less in degree than that accompanying the pneumonia, and there is not the relief from dyspnoea which one expects even in cases exhibiting post-critical hectic. These cases however, are not to be compared in point of severity with those of another series of which I have notes, where the onset has been indistinguishable from that of very acute pleurisy.

In three out of five of these latter there was an initial rigor followed by pleuritic pain of great severity, sometimes causing collapse—cold clammy extremities, pale face, ashen countenance, and subnormal temperature. In one such ease it was at first thought that the patient was passing a gall-stone, (the pleurisy being right-sided) this was however speedily excluded by the detection of well marked friction. Friction was present at the commencement of all save one of these very acute cases which have come under any observation, in one instance being plainly palpable as well as audible. Whether consecutive to pneumonia or beginning as a pleurisy the term acute—as far as the empyema is concerned applies to the rapidity with which the effused fluid becomes purulent as well as to the rate of the outpouring, and this brings me to the point that, several times late
in the pneumonic and in the pleuritic cases, on
making an exploration with a carefully looked hypo-
dermic needle, very early in the disease, on one occasion
before the pleuritic rub had disappeared, clear serum
has been withdrawn, whereas twenty-four hours later
on attempting to aspirate the chest, the effusion has
proved to be purulent, a circumstance which (as
previously remarked) has led me to believe that many
of these acute cases have a short-stage of severity.
It is difficult to determine what circumstances
give rise to this early formation of pus in some
of the cases of which I am now speaking, but in
many of them there has been an underlying infective
condition to account for it; the most acute cases
having been in my own experience related to:
1) Scarlatina. 2) Pyaemia due to absorption from
a wound. 3) The migration of some unpurified madder.
4) In one case the coexistence of pericarditis was
suggestive of a similar septic origin and 5) in
another the empyema complicated a case in which
there had been peritonitis, as a result of which
the left ureter became occluded by dense fibrinous
deposit, and the kidney in consequence was dilated
and firmly adherent to the bowel; this latter was
constructed at the adherent point, and ulceration
had occurred higher up, from which the septic
absorption probably took place. Quite apart from
the pain of the pleurisy, acute empyema is accompanied
by great respiratory distress owing to the rapidity
with which the fluid is poured out, the lung becomes compressed so quickly that the respiratory balance is upset, the healthy organ being unable at once to compensate fully for the crippling of its neighbour, and it probably becomes overfilled with blood (which accounts for the presence of the crepitations so often audible in the healthy lung in cases of acute pleuritic effusion). The right side of the heart too becomes overfilled, and its pulsations may be visible in the epigastrum. To produce these effects, the amount of the effusion is not of necessity large, although the physical signs are sometimes apt to be misleading in regard to its quantity. For even where only a few ounces have been removed with the aspirator there has been dulness on percussion extending to the upper third of the thorax and greatly diminished breath sounds, the reason being that dulness on percussion depends rather upon the extent of the pulmonary area covered than upon the thickness of the layer of effusion, and the diminished breath sounds appear to result largely from an interference with the function of the diaphragm due to its rapid compression (vid. result of experiments pp. 110). In these more acute cases of effusion, the breathing is shallow, and it is worthy of note that inspiration is difficult, and is often in children accompanied by a characteristic grunt or moan. There is increased distress on attempting to lie on the sound side; short, frequent
Searing cough as a rule unattended by expectoration. Vocal fremitus is diminished or absent, and pressure in the intercostal spaces, especially over the area where there had been friction elicits pain. The percussion note is generally absolutely dull and resistant, and the dulness is often at a higher level in the anterior region than anteriorly and posteriorly. The respiration signs are the ones which I have found in practice to give rise to most confusion. Where the patient has been puffed out so rapidly as to compress the lung activity, the breath sounds are generally indistinct but tubular in type; when the coughing has been less active, or after a few days, when the diaphragm has become more used to the pressure, and has perhaps in part regained its function, it is not at all uncommon to get tubular breath sounds fairly well conducted, especially towards the upper part of the dull area and in the interscapular line, a fact which I have repeatedly found to give rise to mistakes or to doubt in the diagnosis. A dyspnea is almost always present in the type of the disease now under consideration.

Case I. Thomas C. aged 5 years came under observation on February 15th, suffering from post-Scarlet fever nephritis of a fortnight's duration. He was desquamating freely; the face was puffed up, especially about the eyes, and there was much oedema of the feet and legs, and of the scrotum. There was no oedema of the throat. The throat was normal, but the glands of the neck were
slightly enlarged on both sides. The heart area and sounds were normal, pulse 110. The percussion notes were normal over both sides of the chest. The breath sound was distant and accompanied by some pleural rubs throughout. Temperature. The urine tested on the following day was teurky, there was a cloud of albumen was precipitated on boiling. Area 2.1%.

February 27th. at four o'clock in the afternoon he began to complain of pain in the left side, and the temperature which had registered 97.6 in the morning went up to 100.4. He was groaning with expectoration. Pleuritic friction was audible at the lower part of the left axillary region. Midnight. He looked paintered and as though in great pain, groaning with expectoration. K. expectoration 60. Pulse 153. Temp. 100.5.

The left side of the chest was moved very little. There was now loud pleuritic crepitation all over the left base anteriorly, posteriorly and in the axilla. It could be distinctly felt over the precordium. The heart sounds were distant. The tongue was purple and he was very thirsty.

February 28th. came. The pleuritic pain was now of very great severity and to relieve this he was dry cupped. An exploring needle inserted posteriorly withdrew clear serous fluid.

Evening. Temp. 101°. pain lessened. The urine passed in 24 hours measured only 50cc, it was bloody, contained a deposit of lithiates. Albumen a cloud on boiling. Area 1.8%.

The percussion note was now dull on the left side, anteriorly up to the 2nd inter-space, posteriorly to the spine of the scapula (it twenty-four hours since the pleuritic began) the heart
At the commencement and of the dyspepsia, cough and feverishness be severe, the eruption may be expected in the course of twenty days or still earlier, but if the pain be more acute and all the other symptoms in proportion, you may expect from these the eruption to be later, but pain, dyspepsia, and flatulence must take place before the eruption of the abscess. These patients recover most readily when the fever leaves the same day that the abscess bursts, when they recover their appetite specially and are freed from thirst, when the abscess discharges are sweet and consistent, the matter white, smooth, and uniform in colour, free from phlegm and if brought up instant pain or strong coughing. These the abscess. When fever does not leave, or when appearing to leave them it returns with an exacerbation; when they leave thirst, but no desire for food and there are watery discharges from the bowels, when the expectoration is green or blood, or fetidous and frothy; if all these occur they die, but if certain of these symptoms supervene and these not, some patients die and some recover, after a long interval. But from all the symptoms taken together we should form a judgment, and so in all other cases.

It is evident from the above graphic clinical account that the eruption mentioned does not refer to the bursting of an abscess into the pleura as stated by Toppe others, but to its lodging into the lung and consequent evacuation by cough and expectoration, which was the usual mode by which it was hoped that the disease would become acute and this too accounted for the frequency of the occurrence of pneumonia shown in

*The same thing is surely to be understood in the aphorism 10, Sect V.— Persons who become affected with dyspepsia after febrile, if they get clear of it in forty days from the breaking of it, escape the disease; but if it passes into phthisis.
was beating in the epigastrium and to the right of the sternum. Respiration 60, Pulse 120. The expelling syringe
was again introduced, and this time it became filled with turbid, lymphatic, thickened fluid. A few hours later, during the
early morning of March 1st, the breathing became greatly
distressed. The breath sounds were almost inaudible. The
heart was beating well to the right of the sternum. An
attempt was now made to aspirate the chest, but the
thorax quickly became plugged after the withdrawal of very
little fluid. In the evening a second attempt was made
to drain away the fluid through a small trocar, but
it proved to be fruitless and after 5½ oz had escaped
the instrument—became blocked and had to be with-
drawn; the breathing however was relieved, the respiratory
sounds more distinct, and the heart beating in the
epigastrium.

March 2nd. He continued restless and anxious, but his
breathing decidedly less distressed. Respiration 48, Pulse
132. Temp. 102°—102.4°. The head passed 200 cc of urine
which was bloody (red) Ur. Sp. 1010, and contained a cloud of albumin.
The distention of the rent and lips was lessened but there
was much of the seroma.

March 5th. The left chest is now completely still both
anteriory and posteriorly. Breath sounds almost entirely
absent. Very faint bronchial breathing posteriorly.
The chest wound freely opened below the scapular angle
and the viscus of thin purulent fluid came away
more escaping into the dressing during the ensuing
days right below. The physical examination of the
chest in the evening (seven hours after the operation) discovered.
The heart beating to the left of the sternum, there was usual
crepitation audible over the front of the chest and the
breath sounds were harsh.

March 24th. The temperature fell to normal after dressing
the wound last night. Percussion note resonant all
over the chest; the breath sounds almost amphoric in
character on the left side and there are numerous coarse
crepitations. Right lung: pleurisy and folds throughout.

Temp. 94.5°; Urine 600 c.c. Sunday, Sp. Gr. 1013. Contains a
cloud of albumen.

So far as the albumen is concerned one need not detail
the events in its subsequent course beyond stating that
the drainage tube had frequently to be changed, owing
to its becoming blocked with lumps of curdy pus, but
it was finally omitted on April 12th and the urine was
entirely healed ten days later. The boy became rapidly
fat and well and on April 20th the percussion note was
resonant throughout; the breath sounds somewhat weak
but vesicular and there were no adventitious sounds.
The edema had entirely disappeared by March 27th but
the urine remained slightly “smoky” and contained varying
traces of albumen until March 29th. After this there was
never any evidence of blood, but faint traces of albumen
continued until April 6th. I examined the patient
in May 1st and again in June on each of which occasions
the urine was perfectly normal. The heart sound
normal, the percussion note resonant throughout. There
sound vesicular. No adventitious sounds.
Case 7. Harriett W., aged 3 years came under my notice on December 24th, 1837. She had been perfectly well until the previous day, when she complained of pain in her abdomen, and her mother noticed that her breathing was short and quick, and that she was feverish. On examination the child was very pale and her expression painful, the pulse rapid, dilating. She complained of pain referred to the left infra mammary region where a pleural rub was plainly audible. The percussion note was everywhere resonant. The breath sounds harsh but vesicular. There was some ronchi scattered throughout both sides of the chest. The heart and abdomen were normal.

Doubtful to an accidental circumstance (being under the impression that she had gone into a hospital) I did not see the child again until December 25th.

She was then in a condition of extreme distress, pale and pinched-looking. The lips cyanosed. The pupils dilated; pulse alternately, about 180. Respiration about 70. She was only using the right side of her chest and was totally unable to lie on that side.

The percussion note was much impaired in the left axillary and infra mammary regions and at the base posteriorly but it was drumming (Shediac) in the upper area anteriorly. The breath sounds were intensely tubular but distant in the impaired areas and one could also hear murmurs, especially on the right side. The percussion note was resonant everywhere and the breath sounds, peculiar in character and vesicular were everywhere audible. The cardiac impulse
was diffuse and sometimes distinctly felt in the epigastrium. Over the base of the heart, was a tendo pro pulvis, synchronous with the heart beats. The extremities were cold, temperature subnormal (97° in the rectum). In spite of every persuasion the parents would not allow me to perform any operation, and she died, somewhat suddenly, a few hours after I had seen her, death being preceded by some convulsions.

On post mortem examination the kidneys, liver, spleen and intestines were normal. The blood was fluid. The bronchial glands slightly enlarged. The right lung had a small, semi solid patch at its base and there was a small area of recent pleurisy over the lower lobe. The right pleural cavity contained no fluid. The left pleural cavity contained about 12 oz. of their purulent fluid. The surfaces of the pleura were covered thickly with lymph. The lung was collapsed and its pleura was bound by lymph to the pericardium, which was thickened, and also covered with recent lymph. On opening the pericardium, both internal surfaces were roughened, feeling when the finger was passed over them like finely grained sand paper.

With reference to these acute effusions, experimental investigations point to the following conclusions:

1. That the respiratory distress depends upon an interference with the functions of the diaphragm or
The diseased side. In every experiment—both upon the
cadaver and upon the living dog, the diaphragm was found
to be almost at once influenced by the intra thoracic pressure
its capsule becoming lowered pari passu with the increase
in the effusion; the contractions however continued after
it became slightly convex downwards, when instead
of acting as an inspiratory muscle—by becoming tense
and flattened—it seemed rather, during contraction, to
enlarge upon the thoracic space; becoming bulged
downwards again during expiration. The diaphragm
therefore on the diseased side was rendered less and less
able to perform its functions as an inspiratory muscle
until at length its contractions instead of aiding inspira-
tion, seemed rather to interfere with it. *Vid p.92. & XLI. p.94.96

The diaphragmatic capsule on the healthy side on the
other hand had its contractions increased in vigour
during and after the introduction of the fluid. The absolute
amount of contraction on the two sides was perhaps not
really different (although it appeared to be exaggerated on
the healthy one) and in order to become of the greatest
efficiency on the healthy side the frequency of the respirations
increased considerably with every increment in the amount
of fluid injected, but the respiratory movements themselves
were shallow. This is graphically shown in the previous
graph tracing. *Vid p.92. & XLI. p.94.96
(2) The diminished breath sounds are naturally the result, not only of the diminished conduction through the fluid, but also of the decreased amount of inspiratory action (diaphragmatic). That portion of lung which is in contact with the fluid quickly becomes collapsed, and the collapse increases as the fluid increases from without inwards (i.e., towards the root of the lung, until the organ becomes flattened and practically airless.

In experiment III of March 23, it was found that the breath sounds became more and more expectorated as the diaphragm descended. The expectorated breath sounds were vesicular in character in every case (in the absence of the larynx - tracheotomy having been performed - they could not be tubular in type). On the directly side the breath sounds became much louder, and harsher, during and after the insertion of the fluid, 4, 9, 9, 11.

Other experimental points - dealing with the effects upon the viscera, etc., will be considered further on.

The type of the disease which commonly succeeds an attack of pneumonia is symptomatically less acute than the one above referred to, and very often the patient does not come under observation until some weeks have elapsed since the primary illness. In these cases the transition of the initial effusion into pus seems to take place very quickly after the termination of the pneumonia, but the relief of the pneumonia symptoms, the lessening of the fever, and the
possible re-establishment of the pulmonary circulation to some extent together with the fact that the sound lung has become accustomed to its increased work during the reparation of its fellows, marks the effects which would have been present if the effusion had taken place in a chest where the lung was previously healthy. The patient generally feels better and his friends consider him better than when the acute pneumatic symptoms existed, and it is only the slowness of the convalescence or the subsequent effects of the increasing effusion which brings him under notice. On looking over my notes I find the commonest histories of these cases to be: "Inflammation of the lungs six, eight, two weeks and in some cases many more weeks ago", followed by temporary improvement, then lasting more or less rapidly and sometimes discharges, giving rise in one case (before admission to hospital) to the impression that the disease was enteric fever. There is generally hectic and night sweats are common. These symptoms together with the cough, dyspnoea and increasing weakness are the ones which have been generally complained of by patients who have sought hospital relief. In this the commonest type of effusion. In these cases, where wasting or had existed for from six to fourteen weeks (in one case much longer) there was external pointing of the parietal pleura of necessity in one of them there being two prominent swellings, situated between the 2nd and 3rd ribs and between the 5th and 6th close to the sternal margin. The swellings in the two other cases being in the 5th left and 6th right interspaces respectively.

The general symptoms of empyema are pretty constant in kind although they vary in degree according to the duration.
of the case, and to some extent also they depend upon the
constitution of the individual. Some patients being more
affected both vitally and nutritionally than others in whom
perhaps the amount of pus is greater. Some, for instance,
were much more rapidly than others and frequently
became pale and cachectic, the amount of the wasting
being very generally in a direct ratio to the amount and
severity of the fever.

This loss of nutrition is always
more or less marked if the illness has lasted for even
two weeks. The skin becomes relaxed and dry and
often chark when felt with the hand. There is pallor,
and sometimes it is noted as being of "earthly" tint.
If several weeks have elapsed the digital extremities become
claudicating.

The patient's complaints as regards the respiratory system
are generally prominent in the history of the case. There is
breathlessnes, which may not be very pronounced so long
as he remains quiet, but any attempt at movement increases
it, and sometimes gives rise to very distressing inspiritory
attacks. In the former class of cases inspiration is often
difficult, a phenomenon which is possibly attributable
to the inability of the diaphragm to relax on the diseased
side owing to the superincumbent pressure (p. 477, 505) and
another circumstance connected with the diaphragm is
the attitude adopted by the patient, who almost invariably
prefers to be propped up or semi-reclining, because
in this posture the weight of the abdominal viscera is not
imposed upon its inferior surface, and its expansion on the
sound side as well as on the diseased one is thus interfered
with as little as possible. It is right that I should
interject here, in case of error, that in older standing
Thoracic effusions, juridical and otherwise, especially when
they have collected insidiously as in latent pleurisy, this
effusion is not by any means so marked, and it is
not unusual for these patients to be going about, with
considerable amounts of fluid in their chests. This was
illustrated very recently in the case of a school boy, who found
during a period of about four weeks that he became more and
more unable to run about the playground, an exercise
which was employed each morning during the past sever
weather. The master noticing that he was obliged to fall
eut each day in a breathless condition, reported the
matter. She was brought to see me, when her left chest
was found to contain 23 ozs of serum fluid.
Where there is much effusion, speech is rendered difficult,
the sentences short and interrupted, the patient being
unable to store sufficient air to complete a sentence of
any length with ease breathe. The voice, in Thoracic
Effusions, sometimes assumes a peculiar huskiness.
It occasionally happens that the effusion acquires a
terrible urgency. Some years ago I was called to see a
girl, nine years of age, who had been suffering for some
weeks from what was described as "asthma." I found her
sitting up in bed, leaning forwards, her eyes staring
and the pupils dilated. The face pale, the lips cyanosed,
and the extremities cold. She was restless and complained
of giddiness and dizziness of vision. The child was
too ill to warrant my making any physical examination.
beyond the discovery that her heart was beating under the
right nipple, and without further delay I hastily went home
for an aspirator, hoping to withdraw the fluid, but on my
return she was dead; the cause having been pulmonary.
Unfortunately no post mortem was allowed and one can
only conjecture that this was a case of pleural effusion-
probably purulent. The chest was much distended on the
left side and the interstices were flattened out.

I have already incidentally referred to the inability of the
patient to lie on the sound side, which symptom for
at all events his experience of some discomfort when
he lies upon it was formerly much trusted to as being
indicative of pleural effusion. In many cases, as
pointed out by Audoul, he prefers the diagonal
decubitus, lying on the back with an inclination towards the
diseased side. This symptom probably results from the
necessity of allowing the greatest freedom to the movement
of the healthy side rather than from the presence of the
liquid upon the mediastinum. Because it is often an
early symptom, observable where small amounts of
fluid have been withdrawn, and especially in the very
acute cases, which are accompanied by severe dyspnoea,
the greater the dyspnoea, the greater is the
inability to lie on the sound side. This point can be
tested clinically, for in some cases of acute pneumonia,
the difficulty of lying on the sound side is considerable
although no weight can be said to be imposed on the
mediastinum by so doing, and furthermore, in pneumonia
and many other diseases incapacitating one lying (if it be of
These days, and for the employment of suction as a sign of
syphilis. But if this expedient line of treatment was
commonly adopted there are also evidences that operatic measures
were less required to. There is little said about the operation
themselves in the books known to have been written by
Hippocrates, he merely makes mention that “when syphilis
is treated either by incision or incision, if pure and white
pus flow from the wound, the patient recover, but if mixed
with blood, sting and mortal they die.” (Vol. IV. Ch. 55. Sect. 35.
Ἡπποκράτιον p. 18) In several of the books of the Hippocratean school,
however, there are allusions to these operations which throw
considerable light upon their nature and object; the
practitioners of that time seemed to recognize that the letting
out of the pus was a successful means of treatment, and
mention is made of it as a means of safety and one to
which prompt recourse should be had; but nevertheless
their fear of the operation was great and they seem to
have attributed the greatest danger to the too speedy
evacuation of the fluid whether serum or purulent, which,
as explained by Galen they supposed to cause “a fatal loss
of the animal and vital spirits.” The operation is already
remarked, consisted either in incision with the knife or cautery,
and was performed not only in cases where the pus had
become partly evacuated through the lungs, but also in cases
where no such communication existed. There is a most
interesting account of a method of confirming the presence of
the pus in the chest, in the "De morbis" lib. 111—where it is directed
that if the patient neither expectorates, nor has the ordinary signs
in the side, he is to be placed in a chair and shaken by the
is a case of subacute nature) this preference for lying on the
affected side becomes manifest. This symptom is
subject-like most of those already accounted for in any variety
and in some cases, where the patient have become accustomed
to the presence of the fluid, they have been able to lie on
other side, or have even prepared to lie on the sound one,
a circumstance which has in past days given rise to serious
miscalculations both in diagnosis and treatment. Wilson
records two cases where the sound side was opened in
error with fatal results.

In physical examination one of the first things to be observed
is the condition of the side. Generally speaking if the patient
has both sides of the chest well enforced in any case of even
a few days duration, there will be noticed some flattening
of the affected side of the chest; a less reliable sign in right-
sided than in left sided effusions because the right chest
is normally of slightly greater circumference than the left:
on this account the chest by measurement would be a more
sensitive one in right sided cases, but it must be
remembered that an early left pleural effusion may
by measurement show little or no comparative increase
owing to the normally larger size of the right chest, which
sometimes in health is the greater by half an inch.

In children, where chest walls are very elastic, the
rounded and distended appearance of the side is often
well marked and is more general than in the adult.
In the whole side looks larger. In older people the
lower part of the chest frequently looks lager out rather
disproportionately to the upper one. In all the intercosta
are wider than on the opposite side. Unfortunately in
the notes of many cases I have few records of the actual
comparative measurements of the two sides of the chest, the
dilatation having been generally observed with the eye, and
it is well known how very slight a degree of distension
may be recognised by simple inspection. The amount of
dilatation depends largely upon the resilience of the chest-
wall and in this relation it may be well to mention
here that the visceral displacements are greater in cases
where the chest walls are rigid than when they are
elastic and yielding. The other point to note in this
connection are the more horizontal position of the lower
jil (8 from the 6th downwards) and the widening of the angle
formed by the costal margin with the diaphragm due to the elevation of the affected side of the thorax.
The intercostal spaces although generally indented out are
not of necessity level with the jil, and their bulging is
still pacer. There is occasionally some inspiratory
reversion of the spaces even in considerable effusions.
In all the notes of cases in which bulging intercostals
were recorded, the effusion proved to be permanent.
Associated with the enlargement of the thorax, is the
diminution or absence of the respiratory movements, tender
more apparent by the increased action of the healthy lung.
In some cases this immobility is noted as having been
absent in others the expansion was deficient or
poor on the affected side, the degree of immobility
varying greatly.
Obstema of the affected side is generally quoted as a sign
of purulent effusion, I can only recollect having observed it twice; one case being that of a man in whom there was
a severe effusion of long standing, which subsequently became
purulent. The other was a child having empyema
associated with tubercular abscesses elsewhere; in this case
there was distinct oedema not only of the sole, the skin
of which became indurated by every crease on the leg below,
but also of the face and eye of the same side. In fact
times this oedema was much depended upon as a
confirmatory sign; it, however, is not an early manifestation
of empyema and its confirmative parity now is obviously
due to the more early recognition of the disease. Most
authors regard its presence as proof of the purulent nature
of the effusion. The best way of detecting it, as pointed
out by Fazekas, is to take up a fold of skin between the
finger and thumb and compare this with a similar fold
in the healthy side of the chest.

Another occasional existence of pus is a unilateral
septate cutaneous blister, and the presence of an internal fluctuating
swelling in conjunction with other signs is prognostic.
Intercostal fluctuation, and the elastic resistance of the
intercostal spaces when pressed upon by the finger, are
indications which merely require to be mentioned; they
are valuable as positive signs, but negatively they are
valueless. It is only occasionally in the empyema, or
where the chest walls are thin that they are observable
and more often in children than in adults.

Examination of loss of vocal resonance is one of the
cardinal signs of thoracic effusion, and is due to
the ill-conducted of the vocal vibrations through a layer of
liquid. In testing the vocal vibrations it is important

to compare limited areas or corresponding points of both
sides and to recollect that absence of vibrations is not

especially more diagnostic. Being sufficient to warrant
the assumption, with other indications, that liquid is present.

Sometimes the vibrations are conducted at some points or
absent at others, it may be on the same level. This being
due to the presence of adhesions retaining the visceral
plasma in association with the parietal.

It will be convenient here to speak of the visceral displacement

of which the most important is the deviation of the heart towards
the healthy side. This is a physical sign of the greatest import-
ance, and is generally present unless there be bilateral effusion
or some other unyielding condition of the opposite lung or
adhesion of the pericardium to interfere with it. This
cardiac displacement is most apparent in left-sided cases,
and the transposition can be traced pari passu with the
increase in the quantity of fluid. The position of the
cardiac impulse therefore varies, in some cases being
concealed behind the sternum, in which case there is
epigastric pulsation; in others just to the right of the sternum,
and in extreme cases it may extend out to, or even
beyond the right nipple line. It is generally most
apparent in the 4th or 5th right-intercostal.

In right-sided effusions the cardiac impulse becomes
translated to a point in or external to the left nipple
line, it is less easy of recognition than the former

displacement. When the misplaced pulsations are
very indubitably palpable the stethoscope is the best means for locating them. In cases of simple pleural effusion which undergo absorption, the heart gradually resumes its normal position as the fluid disappears and in collections which are speedily evacuated, its return to its normal place usually occurs at once. It is sometimes stated that instead of being pushed over by the accumulating liquid, the heart and mediastinum are drawn towards the bony side by the elastic contraction of the formed lung. This theory was introduced by Dr. Douglas Marshall in 1876 in the report of experiments made on the dead body, by which he demonstrated that by puncturing the chest, the thoracic wall expanded by virtue of its own resilience, being relieved from the traction of the lung, and subsequently be endeavoured to prove by means of an artificial model of the thorax that the traction of the healthy lung was capable of drawing the heart towards itself in cases of thoracic effusion. Without discounting the probability that there is some such traction I must confess my incredulity as to its being sufficient to displace the heart in the way that we are accustomed to observe it, and I think that on purely clinical grounds we are able to prove that the displacements are mainly the resinet of pressure by the collected liquid. In the first place because on merely opening an empyema the pus is often forcibly ejected, indicating great pressure, and also from what I have observed in cases of double empyema. On the 19th of last July a patient (Mr. Harris) was admitted under my care at the Stanley Hospital suffering from double empyema which terminated by crisis on the 7th day. Three days
later the temperature which had risen each evening since the
crisis, and had never quite come down to the normal level (99°)
rose to 101° and on making an examination on the following
day the icterus was found to have increased at the left base
and there was absence of local peristalsis. The heart beat
was subternal and there was pulsation in the epigastrium.
Twenty four hours latter my colleague Mr. Herbstt entered
the chest and 27500 of pus escaped. It was subsequently
observed that the heart-beat was in the left nipple line, and
suspecting from this and from the continued icterus, and
other signs that the right side of the chest also contained pus
I at once introduced an exploring needle, which confirmed
this suspicion. This pleural cavity was aspirated next
morning (Aug 3rd) eleven ounces being withdrawn, but two
days later there being great dyspnea, and evidences of increas-
ing effusion at the right base, I asked Mr Herbstt to enter
the chest, which he did, greatly to the relief of the patient,
although only five ounces of pus escaped. Both sides of the
thorax were now open and discharging freely and the
heart was situated normally, the cardiac impulse being
in the 5th left interspace internal to the nipple line.
To make a long story short, in the course of two weeks, there
being no discharge from the left side, and the drainage
tube being generally found on the dressing, the wound was
allowed to heal, but a few days later, signs of effusion
reappeared, and now, with the right side freely open, when
there could be no question of traction by the right lung
the heart became jolted over well to the right of the
sternum by the accumulating pus. The old icterus was
reopened and more than seven ounces of pus came away
and the heart again returned to the left side, after which
the boy made an uninterrupted recovery and is now
perfectly robust. The left side of his chest was slightly
retracted. Before leaving this cardiac sign, it only
remains for me to mention that the axis of the heart
does not become changed when it is displaced as
demonstrated by several experiments described later.

Much less important than the cardiac displacements
are those of the liver and spleen. The depression of the
diapHRagm is less easily made manifest clinically
than the pushing over of the mediastinum, and lowering
of the abdominal viscera is a late symptom, only
observed in copious effusions. Stokes thought the relax-
ation of the diaphragm to be the result of an inflammatory
action causing its paralysis, but it has to be borne in
mind that the extra-abdominal pressure is greater
than the intra-thoracic, and that this may in part
account for the lesser frequency of its visceral displacements.

It is extremely rare that the liver or spleen become
greatly depressed one or two fingers' breadth below the costal
margin being the usual maximum extent seen at the
present day, but formerly the effusions were retained
so long that it was not uncommon to have the liver
greatly lowered. Some cases record a case where it extended
down to the iliac fossa and the patient was thought to
be suffering from an enlarged liver until parasites
of the thorax restored it to its normal position (Cycl:.
J. Reid: Albert Indianapolis). It is stated that these abdominal
displacements are greatest in cases where the patient has been going about, or where he has been propped up in bed. Considering that left subpneumonia is the commoner, one would a priori respect the pleural displacement to be more frequent than the collapse, as a matter of fact, however, I can find few records of the former either in any one or other published collections of cases, whereas the latter is rather commonly stated as having been present.

The results of experiments which were made with the object of throwing light on the various displacements in thoracic effusions have proved interesting.

I. Regarding the heart.

1) It is evident from the observations made on the cadaver that the heart begins to travel towards the healthy side when only a very few (between five and nine ounces of fluid) have been injected (p. 97, 1881) and the same was indicated by feeling the cardiac impulse from the under surface of the diaphragm during the injection of fluid into the pleura of a dog. In experiment No. III (p. 97, 1880) the impulse travelled to the left when 2.5 c.c. had been inserted.

2) There is no pendulum-like movement of the cardiac apex. The axis of the heart remained unaltered after very large amounts of fluid were injected and after it had travelled quite over to the right side; but some rotation appeared to take place on an axis parallel to the long axis of the body because in every experiment, more right-ventricle than normal was visible on comparing the anterior aspect of the organ — i.e., the heart appeared to have rotated from
right-to-left (in a left-sided effusion) that this was not
the result of the overfilling of the right ventricle, as indicated
by its taking place in the cadaver as well as in the dog.

(3) In every experiment some descent of the heart
was observed as well as its rotation to the right (the injection
being into the left pleura). This was demonstrated by the
movement of the syringe inserted into the aorta (p. 103) and
the position of the latter behind the right auricle in the
cadaver and in the dog indicated the same thing. This
descent appeared to be in part due to the distension of the
upper portion of the pleural sac as shown in the twins (p. 97)
but was also aided by the descent of the diaphragm on the
diseased side. The fulness of right auricle as often noted
in left pleural effusions would be accounted for by the
lowering of the aorta as well as by the distension of the right
ventricle which was observed in experiment No. 10, p. 101.

(4) The displacement of the heart is not caused
by retraction of the lung. The lung on the healthy side became
extended. In experiment 2, after the injection had been
completed, the intercostal muscles were carefully excised
away; the pleura and subjacent lung then bulged through
the interstices, showing (in the dead subject) no retraction
of the lung. On opening this pleura so that the lung
retracted - there was not the slightest movement of the
heart towards the diseased side. See page 91, 577.

(5) The right-ventricle is largely covered by the margin
of the right-lung. This was observed twice in the cadaver, by
noting the point to which the margin of the lung reached before
opening the pleura (p. 92) and it was confirmed in the dog by
retaining the lungs in the respiratory condition by clamping the
trachea before opening the chest. The outer 2/3 of the body of the
right-ventricle remained covered by lung. The aorta was also
covered by a projection forward of the inner pulmonary border.

During contraction of the heart, this thin
margin of lung was projected forward, so that the inferior
pulm coming during life is probably transmitted through this
portion of right lung.

II. The Spleen and Liver

To study the depressions of the abdominal viscera it is
necessary to investigate the undersurfaces of the diaphragm,
in any obscure effusion as before remarked there is a
bulging downwards of the central portion of this structure
on the affected side, so that it presents the outline seen on
the left half of the following tracing, which is taken from the
plaster cast mentioned at page 87.

It will be noted that near the margin of attachment there is a
cavancy. This cast was taken from an animal in
which the right thorax was injected, but exactly the same
thing was observed when the left side was examined.
shoulders (his hands being held by assistants) in order to ascertain the situation of the pus by the splashing sound, and if this test failed, yet they were not to be deceived, but were to know that the thorax was full of pus, by the difficulty of breathing, the swelling of the foot and the cough; then, in order to ascertain which pleural cavity contained the pus, the chest was surrounded with a snoring which had been dipped in hot water containing vermilion (sublimate liquida) thoroughly ground, and whichever part of this did first, indicated the portion in which the incision with knife or curet was to be made. It may be well to mention here that in the second book of the Dr. Marvel it is recommended that the opening be made in the side which is most swollen and most painful, low down rather than in front (it with the patient on his back) in order that the pus may escape more readily, a remark which proves the antiquity of the surgical principle of making an incision for drainage at the most dependent part, and another most interesting historical point is the observation that when the pus was thin (watery) a porous drainage tube was to be introduced—which was gradually shortened to allow the wound to heal. Then the knife was used, in one book of the Dr. Marvel it is stated that before making the incision the skin was marked; but elsewhere it is simply enjoined that an incision was to be made into the skin between the ribs with a knife, and then the adjacent part were to be perforated with a pointed knife, guarded by having a piece of rope wound round it—that only a portion the length of the thumb nail remained exposed. On reaching the pus some of it was allowed to escape and the incision was
The percussion note in such cases has already been described as absolutely dull and resistant over the limitations of the effusion and it constitutes the most important of the cardinal signs. It generally gives no indication as to the amount of the effusion but its level as noted from day to day in these cases gives valuable information regarding the rate of increase. As before stated, in very acute cases there may be a considerable area of dulness caused by a comparatively thin layer of liquid. I have many times endeavored to ascertain whether by altering the patient's position the level of dulness could be modified, and although sometimes in cases of moderate effusion there has seemed to be some appreciable alteration, in general it has proved too uncertain to be of any clinical value. The dulness however is frequently noted as being of greatest extent posteriorly, and in the axilla, whereas anteriorly there is sometimes complete resonance, or it extends to a much lower level. This is probably the result of the common diagonal adhesion affected by the patient, which allows the fluid slowly to collect at the most dependent part. It must be remembered that the diaphragmatic line continues from the 8th rib upwards in cases of effusive effusion and that its limitation...
by the 2d rib or its entire disappearance and replacement by a dull note on percussion will indicate an effusion of great magnitude.

(The sketch at page 101 shows how the upper part of the lung in the dog remained inflated with air and accounted for the resonant note on percussion.)

An abstract of the accoutentary signs in the cases of empyema and other acute pleural effusions which I have observed proves them to be less constant than any of those mentioned hitherto; for although the breath sounds are often cited as "absent," they have more frequently been "weak" or "faintly conducted" and when this has been the case they have very generally been tubular in type. This absence or imperfection of the breath sounds is a characteristic which although the most common—and always a valuable negative sign of effusion—is unfortunately subject to exceptions which have frequently led to errors in diagnosis, for in a limited number of cases the breath sounds—again tubular in type—are quite loudy conducted, it may be over a considerable area where there is dulness on percussion and loss of precussion. It is difficult to account for this condition of tubular breathing in all of these cases, for it may exist quite apart from the presence of adhesions and in places from which the pus or serum can be withdrawn with an acriminator. I know of several instances where effusion having been diagnosed by the practitioner, the surgeon called in to operate has cancelled delay on account of the doubt which the presence of the tubular breath sounds has raised in his mind regarding the diagnosis, and in one
such case—-as being pressed to perform paracentesis a very large quantity of pus was evacuated. The exploring syringe or hypodermic needle is in these cases a very valuable means for putting the question at rest and it is rare that not actually where there is any doubt, but it must be remembered that failure to withdraw pus or serena with it is not always conclusive evidence that none is present. This accident is generally due either to too fine a needle being used or to its having been purified with some solution which coagulates the effused liquid and so prevents it passing into the syringe of the instrument. On this account it is important either to use a solution of boracic acid (which is best) or having purified it with carbolic solution or other of the stoppage disinfectants, to wash this out with boiled water before inserting it into the chest. This precaution is particularly useful in the case of the aspirator which is so apt to become plugged with coagula.

Almost more misleading than the instance which I have just mentioned is another condition which gives rise to tubular breath sounds when pus is present, and that is the existence of adhesions, proper these when they are of any extent, either insular or linear. The respiratory sounds are almost invariably tubular and well constricted. The case which I have here illustrates this and shows how the diagnoses was further marked by the use of the syringe which is generally so valuable an aid. This patient's chest contained pus for about seven weeks, which although suspected could not be found on exploration, for although on several separate occasions the needle was inserted at different points—-nothing—-or some blood—was with-
drawn owing to the circumstance that an adhesive joint was punctured each time.

Case 17. Charles R., age 11/2, was admitted to the Children's Hospital at Poughkeepsie on October 10th, 1896. With a history of being last ill for about ten months, the infant had suffered from cough but had never expectorated blood nor was there any history of night sweats.

The family history was fairly good.

On admission, he was much emaciated, anxious, coughing, the lungs and chest chested and there was much seamy hair in the back and limbs. The chest was sunken below the clavicles on both sides. The movements of the right side were deficient. The percussion note was uneven, and the breath sound weak. The percussion note was especially dull over the upper third of the right side, and the breath sound diminished in character.

On the left side there was impaired percussion and constant breathing down to the third rib. No condensation pounds. The temperature was hectic in character.

On October 19th the right base was explored, and an ounce of clear sanguineous effusion. On the following day 3/4 of an ounce were abstracted through a subcutaneous trocar, but bright blood appearing the instrument was withdrawn. After this there was improved percussion of the right side and the general health became steadily better until November 27th, when he was able to get up.

On December 22nd the temperature which had previously been normal, began to rise, and from this date until December 21st presented evening exacerbations. On December 15th it was noted that there was some slight dulness at the right base and the breath sound
were diminished. On exploration with a needle nothing was withdrawn. On December 21st the dulness in percussion extended to the 5th rib, but on again exploring posteriorly some blood was withdrawn. Here was also at this time impaired resonance at the apex of the lung and the breath sounds were bronchial. There accompanied by fine crepitant sounds.

On January 10th 1886 there was no change for the better. The breath sounds were bronchial and frankly bronchial. It was now believed that the case was one of chronic pneumonia of tuberculous origin. No fluid could be found on exploration.

On January 21st while auscultating the anterior aspect of the chest, just in front of the anterior axillary line - where there was a peculiar or fissure-resonant note on percussion - the breath sounds seemed to be amplified in character (a fissure had been suspected) and while actually listening there breath sounds suddenly and entirely disappeared, and the percussion note simultaneously became dull. There could be only one explanation for this - that an adhesion had given way, allowing fluid to extend - so again the needle was introduced, and this time it filled with thickening pus.

Next day (Jan 22nd) three centimeters was performed and 2½ pints of foul pus were let out. The temperature remained hectic in character until April 1st when it became normal and steady. A bronchial fistula became manifest by the dripping of the spu - the lung's fluid ceased for washing out the chest, and by the circumstance that this operation set up coughing followed by the escape of some of the fluid through the mouth.

On May 8th the tube was left out, and the sinus was healed in
a few days; but a fresh collection took place which required the

syringe to be replenished on May 20th. On June 24th the knife
was finally left out and on July 7th he was able to leave the

hospital, his chest being contracted but the resonance very

good, except in the immediate neighbourhood of the wound.

Breath sounds peculiar but weaker than on the opposite side.

He was re-admitted on July 24th; the syrinx having opened
again and there was found to be a small pouch about 2½

inches deep, which being drained the syrinx quickly and entirely

healed and he again left hospital on August 22nd. Later

in the autumn of the same year he was suddenly attacked

with intercurrent meningitis, and died at home after a few

days illness.

There are just two other points to bear in mind in connection

with the breath sounds viz. that in nearly every effusion there

is some respiratory movement audible in the intercostal

space and in a corresponding area alongside the vertebral

column. To the base of the chest; and secondly that in children

especially, the respiratory sounds from the affected lung,

usually quieter in character may be very distinctly heard

over the cleared side, and may be known to be those

conducted by their intensity increasing when traced

towards the healthy lung.

Asphyxymy is present or absent according to the amount of

the effusion. It is a variety of bronchopneumonia, modified by

transmission through a thickened layer of fluid. There-

only remains to be mentioned a variety of asphyxymy described

by S. Bocchi of Rome and known as the "pneumotique asphyxyme"
which be regarded as a means of delimitation between serous

embrunent-collecting. In the former, when the patient refused

the usual "one-two-three" in a whispering voice, the sound

was described as being conducted very clearly and without

blurring of the articulation (either in the ear directly applied, or

through the envelope), whereas in the latter, this condition was

absent. I have tested this means of diagnosis many

times, and have found it of very doubtful utility; at all

events it has seemed to me sometimes to have been

present when there was pain, and absent when there was

none.

Chronic Emphyema.

This requires little mention here, its clinical features, being practically

the same as those already detailed. If the pus has been evacuated

whether by bronchial puncture or by operation, there is generally

contraction of the tube. Many cases proceed from chronic

serous effusions or from neglected purulent ones. Their

course is very prolonged and only shortened by operative

means. They are practically chronic abscesses of the

pleura, unable to heal because the cavity cannot be

obliterated. The lung in these cases is so compressed a

carrapex, and bound down by organised membrane, that

its expansion is hopeless. That recovery may take

place however, even in cases of long duration and of great

duration is demonstrated by the second case here appended

(not one of my own). The result in these chronic cases

will of course depend upon the nature of the original disease

of which the emphyema is a sequel or complication, and

upon the condition of the lung as to its expansibility.
Case: Drusilla H., 26 years, was admitted to the Hospital at Pendleton on November 3rd, 1885. She had been ill for twelve months, and at the commencement of the illness her medical attendant wanted to open the chest but was not allowed, and nothing was done for nine months, when 20 lbs. of pus were removed by means of a trocar.

On admission: She was anaemic and decaentric. Inspection normal. Sputum abundant; sputum profuse in character. The left chest was dull on percussion. There being a great degree of resistance, vocal fremitus absent. Breath sounds were normal.

There was a marked dorsal lumbar spinous curve, the curvature being to the left. The cardiac impression was just below the right nipple.

November 10th: An incision was made into the left chest, below the scapular angle and twenty-five ounces of dark pus tapped off. Two tubes were inserted, and antiseptics were employed.

November 15th: The discharge was offensive. The chest was washed out with weak carbolic fluid. On November 28th these began to appear traces of albumen in the urine.

December 15th: Traces of lymph came away on removing the tube.

January 9th, 1886. Temperature markedly better; discharge not offensive and discharging quite freely from the tube, but it allowed its collet in pocket in the pleura. The lung showing no tendency to expand, a tube fitted with a valve, allowing pus to escape, but preventing air from entering, was inserted in the hope of encouraging expansion.

February 5th: Resection of part of the 7th rib was performed for the next four weeks she improved; then the temperature again became hectic, and she began to lose ground rapidly.
no improvement occurring her friends were allowed to take her home on April 19th and she died in May. The post-mortem examination was granted.

The following is an abstract of a case quoted by Dr. Marshall (Medico-Chirurg. Trans. Vol. I. 1831. p. 27). A clergyman in Cornwall at 26 yrs. got an attack of pleurisy which seemed to result from stretching himself to reach a book on a high shelf. He was blistered and otherwise treated for about three months, at the end of which period he was so ill as to be obliged to relinquish his curacy. For four years after this he remained an invalid, suffered from dyspepsia, and became anaemic. He then consulted a physician who discovered that the left chest was firm and smooth and the carotid pulseless to the right of the sternum. Paracentesis was performed and eighteen ounces of very purulent pus came away. The orifice was kept open and for some time many ounces flowed out each day. About one year later he consulted Dr. Williams in London, who was then much succeeded; his side contracted so that he leaned towards the affected side when walking. There was difficulty of breathing, pulse 100. The breath from the sinuses was very offensive. The respiratory murmurs were in six parts audible except at the interscapular space where distinct breathing was heard. He remained in this condition for another year (six years and four months since the onset of this illness) and was then admitted into St. Bartholomew's Hospital. The sinuses were then explored with a large gum catheter, which, after passing through a tortuous channel for nine inches, entered a cavity from
since forty-four ounces of dark, dirty, decomposed pus, which
was of a most offensive sulphurised hydrogen stench, came
forth. The next day another forty-four ounces was withdrawn
in the same way, and during the seven ensuing days, one
hundred and twenty-seven ounces of pus were evacuated.
After this the amount secreted began to decline until three
weeks later it averaged 30 to 40 ozs a week (i.e. four to five
ounces a day) and his general health became considerably improved.
His chest was expectorated each morning with warm water
and after this had been repeated daily for about two weeks,
the amount of discharge was only about one or two ounces
a day. He was given a liberal diet—wine, porter
gin, bitter infusions etc. for another three months, and
then it was thought expedient to enlarge the opening
in his chest, which being done the secretion rapidly decreased
and he recovered without a drawback. He became quite
well, the left thorax almost expanded to its normal
size, the respiratory movements could be traced down to the 12th
rib but some dulness remained at the base, on percussion
he rapidly became strong and heavier than he was before
his initial illness, which occurred just seven or eight years
before the final notes of his case were taken.

The sequence of pus from scrofula—may be conjectured from the
nature of the initial disease whether septie or infectious; from the
occurrence and repetition of fevers and from the presence and
persistance of hectic with sweating during sleep and restful waking.
These existing either from the beginning of the illness or after-
running in a case where there has previously been effusion of pus.
Then plugged with a strip of linen tent fixed to a thread. This was
removed twice daily (so that the liquid might be gradually
evacuated) for ten days, at the end of which period the cavity
was allowed to empty itself and in order that the lung should
not dry too quickly, being accustomed to the presence of a liquid,
warm wine and oil was injected through the puncture. As before
noted, much importance was attached to the gradual evacuation
of the pus by the Hippocratic school, and the difficulty which they
encountered in effectually controlling its escape by plugging
a wound of the soft parts with the linen tent, is said to
have led to another frequent practice — that of perforating a
hole (after making an incision through the skin) with a sharp trocar
so that they might have a rigid structure to cope and without
so to speak, as they found necessary

The writings on medicine during the five centuries which succeed
the Hippocratic era do not appear to indicate any change
either in the methods of diagnosis or of treatment detailed
above. Celcus makes no specific mention of empyema
in his writings on perioperative, but in his chapter on
fractures of the ribs (Lib. viii. Cap. ix.) he refers to empyema as
a complication; he however does not make a very clear distinction
between what might be a total abscess, unconnected with the
pleural cavity, and a pyothorax, but in any case he
emphasises the necessity for speedy operation with the
cautery, by thrusting it through the most swollen part, and in
the event of there being an external swelling, he instructs
that the part is to be smeared over with limonene chalk
(probably fuller's earth) and that at whatever spot this remained
longest moist, the pus would be most superficial and that the
The pupils are frequently dilated where there is pus and this presence would be indicated also if there were bulging interspaces, external pointing or bulge of the side. As before remarked Baccelli's peculiar signs of pneumonia are not peculiar the least means of distinguishing the nature of the effusion in the exploring syringe, and in the event of no fluid being withdrawn the sensation of the needle being freely movable in the cavity of the pleura would suggest the placing of the instrument. In some cases the general asthenic character of the illness is indicative of pus, the disease assuming a typical character.

Complications

Bronchial fistula: - It occasionally happens that an empyema terminates by discharging itself through the lung, in which event the patient suddenly coughs up a large amount of pus sometimes sweet but often horribly fetid. The mucus varies in color from green to yellowish, or it may have a dirty reddish tinge from the admixture of blood. The physical signs in the chest are generally immediately altered owing to the entrance of air, the signs of pneumothorax supervening; but this is not essential, and it explains the absence of pneumothorax in these cases. The local physicians were accustomed to state that the pus was absorbed by the pleura and of in excreted by the bronchial mucous membrane. It is now known however that the entry of air may be prevented by a valvular opening. In some cases on opening a thorax where no signs of bronchial fistula had previously existed the pus has been entirely fluid. I believe this to result from the presence of a small alveolus not yet
separated from the spot where the pustule would eventually appear. It has so frequently happened in my practice that purulent expectoration has commenced within a very few hours after the performance of thoracocentesis, both in cases where the pus has been infected as well as when it has been offensive that I believe there must have been in these cases a valve-like plug (septic or aseptic) which only became separated after the relief of the intra-thoracic tension.

Adhesions—may be regarded as complications of empyema, although they in some cases give rise to the cystic or localized variety of the disease. In two cases which I have seen just written they have been linear, extending from below downwards and separating the thoracic cavity into an anterior and a posterior chamber. In one of these the posterior chamber had been evacuated by an intercostal incision, but the anterior one was full of pus and in this case the pericardium was filled with purulent fluid. Of cases observed clinically, the one recorded at page 99 of the book must have had several similar adhesions since the pus was all evacuated by a single incision. In another case, (Oregon, p. 111) there was a small cystic collection separate from another occupying the remainder of the pleural cavity.

The following is the abstract of a case in which there was a localized empyema situated at the apex of the left thorax and consecutive to acute pneumonia.

Case—Ada Seddon aged 28 was admitted into the Stanley Hospital on Feb 12th, 1874. Six weeks previously she had been injured with a pipe and this was followed by pleurisy and pneumonia.

After being ill for about ten days, she began to recover, but a week
Later she again had a fever and since that time has suffered from cough, breathlessness, emaciation and increasing debility. On admission—she was pale, looking enfeebled. She lay constantly on her left side. The breathing was rapid and shallow. The right chest was resonant. Respiration. Breast sound harsh, occasional, no adventitious sounds.

On the left side there was dulness on percussion, extending from the apex to the side of the heart. The percussion note became hyper-resonant. The vocal fremitus and resonances were much impaired. The temperature was hectic in character. The voice was hoarse. The displacement of the heart was noticed.

About five days after admission she suddenly coughed up a large quantity of greenish yellow pus. It came in such amounts that she was in great danger of being suffocated and had to be inverted over the side of the bed to prevent this accidient. The physical signs at the left apex were immediately altered after the escape of the pus. The percussion note became hyper-resonant, the breast sounds loud and blaring and there were loud, coarse expectorations. The breast sounds later on became harsh, vesicular in character but the expectorations persisted for many weeks after the had become an outpatient. Eventually she became perfectly well in health but when last seen (July 1874) there was some impairment of the percussion note over the left apex. The breast sounds were vesicular and there were no adventitious sounds.

Pericarditis: is an occasional complication and is generally dependent upon the condition which originated the empyema.
If effusion occurs it is apt to be purulent as in a case mentioned formerly. It is worthy of note here that pleurisy as well as pericarditis which results from pleurisy is seldom followed by purulent effusion.

Cardiac Disease: May result from chronic suppurative as from any other chronic suppurative condition.

**Diagnosis**

Pelvisia: The hectic sweating and dyspnoea together with the regularity of the pleuritic signs may give rise to some doubt.

The extent of the disease, however, and its usual limitation to one lung will almost always, in conjunction with the history of the case afford a means of distinction.

Anæmia: Is seldom directed particular attention to the pulsation.

Sometimes the pulsation has been in an external swelling (pulsating effusion of necessity) in others it has been limited to the intercostal spaces. In case of either description has presented itself to my own practice, but the diagnosis would depend upon the situation of the pulsation, the absence of thrill and of beat, and upon the presence of the four signs of empyema.

Catale Placae: Requires to be mentioned because occasionally a pointing suppurative has been opened in mistake for one of these. I have noted of such a case. The diagnosis obviously present no difficulties.

Case: - George B. Art-10. Admitted to the Children's Hospital, Philadelphia, January 3, 1857. He had been ill for about two years, but alientant dating from an attack of pleurisy which
Clinical for two weeks. Four months ago a swelling appeared in the right breast which was opened as an abscess, but it evidently (from the history) communicated with the pleural cavity. A tube was inserted, and the discharge has been free from the sound ever since.

On admission, he was fairly nourished, but pale, finger clubbed. There was a large sinus in the 8th right intercostal space, in the middle line—passing downward and inward from this there was a free discharge. The percussion note was dull from the 5th rib downward and the breath sounds in this area were very weak. On January 32nd under chloroform, a probe was inserted and it passed in for nearly eight inches. The chest was incised 1½ inches below, and just external to the angle of the scapula and some offensive pus escaped. The chest was from time to time washed out with warm lye, and gradually the old sinus became healed. After its closure the new opening was allowed to granulate and he left the hospital cured on March 10th.

Subsequently it was ascertained that the wound broke down and began to discharge again.

Pneumonia— is the disease for which thoracic effusions are most frequently mistaken, chiefly on account of the bronchial breathing and bronchopneumonia sometimes present in the latter. The absence of pneumothorax is the most reliable distinctive sign. This may however be absent in pneumonia when the bronchi are occluded with exudate, in which event also the breath sounds and vocal resonance may be diminished. In doubtful cases the exploring syringe is the best guide.

Malignant Disease of the Lung— is very apt to be mistaken
for a chronic thoracic effusion. I remember very well some years ago (when pathological to the Royal Northern Hospital) making a post mortem on a case which had been admitted as being of this nature. There was an enormous incompressible growth of the right lung which during life had obscured the chest and the breath sounds, vocal resonance and resonances were absent. Serous effusions, however, are frequently the result of cancerous growths, and if an aspiration of a chronic effusion the fluid proves to be blood tinged, it is very suggestive of malignancy.

An enlarged liver—sometimes very closely simulates a right-sided effusion. The extension downwards is apt to be mistaken for a depression of its margin by the fluid, and its extension upwards, elevating the diaphragm, distending the pector, and causing perhaps some local pulmonary collapse is not unlike an effusion. It is not difficult to distinguish, if it be borne in mind that to cause depression of the liver a considerable effusion is necessary, and the dulness will extend far up both anteriorly and posteriorly if there be a sufficiency of fluid to account for it. Tenderness is present over some of the dull area and the extension of the breath sounds is louder than if the dulness proceeded from fluid. The heart too is not displaced (unless it be upwards) by an enlarged liver, and furthermore the area of resonance on percussion is often increased downward if the patient be asked to take a deep breath.

The specimen of which I show a photograph was obtained from a case in which the diagnosis was obscure. The patient was an elderly man who came to the Royal Northern Hospital.
complaining of pain in the hepatic region. His liver was large and very tender. There was hectic and wasting, but there were signs of effusion in the right pleura and empyema was suspected. On making a puncture, pus freely entered the syringe and the side was opened and drained; but although there was temporary improvement the man died in the course of a week from exhaustion. The possibility of there being an abscess of the liver, related to the empyema was entertained from the first and the post mortem proved the case to have been an abscess of the right lobe of the liver which had suppurated, and the pus eventually perforated the diaphragm and set up the purulent pleuritis which was present when he came under notice.

The preparation shows the thickened, lymph covered pleura, and the ascetic fluid which had made its way into the pleura from the liver.
Pathology

Pneumonia - is the commonest antecedent of empyema both in adults and in children. It is interesting that while I was resident in children's hospitals, the cases resulting from pneumonia were all admitted for the sequel disease, whereas of fifty six cases of empyema pneumonia, calculated by myself as having been under treatment in the General Hospital for Children at Manchester, during the year 1855, there was not a single instance in which empyema resulted, and this experience is borne out by the reports of the previous four years. In all during the five years 1851-55 there were 235 cases of empyema pneumonia treated in the hospital, and of these only one became empyema (Vid. Medical Abstracts 1851-1855.)

Broncho-pneumonia - is also occasionally accompanied, or followed by empyema.

Pleural - is sometimes purulent from the first, or the effusion after remaining serous for some time becomes purulent. It has been stated by some (Bezems, Stokes on) that purulentities in a serous effusion is apt to render it purulent. This is not likely if care be taken to purify the instrument carefully and to prevent the entrance of air; the aspirator has increased the risk of this greatly. When empyema is immediately preceded by acute pleuritic symptoms, it almost invariably complicates some other disease, or there is an underlying septic or infective condition. I have already exemplified some of these cases. In making post mortem examinations in septic cases of scarlatina I have several times found pus in the pleural cavities and I have
...note of one case of empyema which occurred in a girl suffering from acute Bright's Disease, without any ascertainable history of scarlet fever. It succeeded an intercurrent attack of pneumonia. Tuberculous Deposits in the Pleura:—have been known to give rise to the disease but the effusions in these cases are more commonly serous. Tubercle bacilli have been demonstrated in the pus in some cases of tuberculous empyema, and Chanfrard and Combet have produced tuberculous in guinea pigs by subcutaneous injections of the serum fibrinum fluid from pleural in tuberculous subjects. It has been observed by some that empyema is never followed by pleurisy, whereas simple pleurisy with serous effusion is frequently the precursor of that disease. My impression is that this idea has arisen simply from the fact that tuberculous pleurisy is common and that it has little tendency to suppuration whereas the commonest causes of empyema are non-tuberculous.

It was long ago observed that the occurrence of empyema or of pyo-pneumothorax in pleuritic patients seemed to arrest the disease, and that much improvement resulted for a time; this was explained by the compression and devascularisation of the lung, which was thought to stay the progress of the trouble locally, and by the increased action of the other lung which gave rise to distension of its minute bronchi, thereby preventing the accumulation of tuberculous fluid (sic) Stokes—Disease of the heart. Disease of the Vertebral Column and Injuries of the Spine and Sternal have occasionally originated this disease, and injuries may occasion it either directly (e.g. fractures of the ribs) or indirectly by causing an effusion of blood into the chest, which afterwards...
suppurates itself, or acting as a foreign body causes suppuration

Foreign Bodies:—Such as bullet as are recorded as causal
agent, but cases arising in this way are fortunately rare. I know
of one instance where a drainage tube was lost in the pleural
 cavity and never recovered. The wound became healed
up and the patient is now perfectly well, suffering no incon-
venience from its retention.

Prognosis

The prognosis in early cases depends largely upon the cause of the
disease. Septic and septic pneumatic cases very often recover.
But in most of those having a syphilitic origin the prognosis is bad.
the age of the patient constitutes an important element.
Children almost invariably recover after operation. The results
in adults have been less satisfactory as regards absolute
recovery, there being more tendency for the continuance of permanent
residuals and of contracted thoraces. The occurrence of a
Cornelian febrile adds gravity to the case immediately, because
the pus may become involved into the lungs and give rise to
septic broncho-pneumonia, and remotely on account of the
permanent deformity and impaired health which is apt
to recur unless immediately treated by operation.

Suppuration has occurred from the sudden discharge of an abscess
into the pleuritic. I witnessed an approach to this accident
in a patient—whose pneumonia burst—while I was in the ward
(see page 81) and I believe the wound would have been placed in great
jeopardy had not inverted her over the side of the bed.

The prognosis in an untreated case is bad. Both as regards
cavity should be inserted there. This it will be seen is

contrary to the practice of the Hippocratic writers, who state that

the pus is to be found where, owing to the mixture of serous and

water, pus occurs; a difference of opinion which would seem to

indicate that the method was somewhat unreliable. The

reasons for thinking, that caloric here referred to syphAfrica are, that

be attached to this absence of external swelling and to the necessity

for enucleating the body after the operation, to prevent a taint which

would prove fatal; and furthermore he states that in some cases

instead of pus there is an internal collection of a fluid like serum

a serous effusion.

Galen added nothing of importance

to the knowledge of this disease; he appears to have preferred

perforation of the chest, as exemplified by his well known brilliant

case of mediastinal abscess (called syphymor) in which he removed

a portion of the sternum, laying bare the heart, and so giving

issue to the pus; but that he recognized true syphymort

to contrast from the manner in which the records his practice

of injecting honey water through the ulcer, and having shaken

the patient well, if placing him on the affected side to allow

the fluid to escape, to recover which the dark water was

directed to cough violently. He elsewhere remarks that

after a fit of coughing the patient sometimes spat up some

of the honey water which had been injected into the chest.

I have already indicated that up to this period no medical

change had taken place either as regards the method of recognising

syphymort or the means adopted for its relief and I have related

the former somewhat in detail because they became

traditional. The teaching of Hippocrates having been retained

down practically unchanged from century to century until
The immediate prospect of life or the ultimate perfect restoration to health. In some few cases the pus has been known to undergo absorption. The prospects in chronic empysema is also unsatisfactory.

Experiments made in connection with the effects of Thoracic Effusions.

Experiment No. 1: On the body of a girl aged 16, Death from Diabetic Coma. It was ascertained during life that the heart was normal in position and area. The apex beat situated normally. The liver dulness was normal. Spleen not palpable.

I

The skin (without the muscles) having been reflected from the front of the thorax, a needle four inches long was pushed through the 6th interspace, into the cardiac apex; its direction being vertical. About 90 c.c. of water were then gradually injected into the left pleural cavity, the result being carefully recorded.

II

While the first 90 c.c. were being injected the head of the needle became inclined slightly towards the left, in a direction parallel to the transverse axis of the body. It continued to move in the same direction until about 27 ounces had entered the thoracic cavity, when its direction of movement began to change — to a diagonal one, upward and to the left. The head of the needle had by this time travelled through an arc of about an inch. When about 56 ounces had been injected the needle formed an acute
angle with the thoracic surface (to its left) and its head pointed towards the left nipple. At this time the tension became so great that the needle parted company with the heart.

III

When the cardiac style began to travel upwards, it was noticed that the abdomen was further more distended than before the embolism was commenced, and a second needle was then inserted into the left lobe of the liver just between the diaphragm and the left costal margin as the fluid increased. The head of this needle gradually moved vertically upwards—parallel to the long axis of the body—indicating that the left lobe of the liver was travelling downwards.

IV

Having completed the injection—the left side of the chest looked much distended, and the angle between the left costal border and the liver ala was widened. The percussion the ascendantable cardiac dulness extended 2⅔ inches to the right of the midsternal line. The absolute dulness being just internal to the right nipple line.

V

The muscular structures (which were bulging) were unsheathed from the right intercostal spaces, and immediately on their removal the pleura and subjacent lung bulged through the interspaces.

VI

The margin of the right pleura reached just to the sternal border. A small triangular portion of pericardium was visible at the lower and inner part.
The extended left pleura peeped from behind the sternum for ¼ inch in the 2nd interspace and gradually slipped away downwards and to the left behind the third rib.

VIII

A vertical longitudinal section was now made of the sternum from the 2nd costal cartilage down to the seventh, and the right-half, together with the cartilages of the 3rd, 4th, 5th, and 6th ribs, was removed, leaving the 2nd costal cartilage and the 7th. The pleural membrane was then incised and the lung retracted about 1/4 an inch. No movement of the heart to the left was observed.

IX

The pericardium was now exposed, as much as was visible extended 1/4 inch from the mid sternal line in the first interspace, two inches in the 2nd and 3rd. The diaphragm was arched upwards and extended to the lower corner of the 2nd costal cartilage at its junction with the ribs.

A tracing was now taken without further distending the parts. ( Vide Tracing No. 2.) The photogravure shows the dissected pericardium.
The cut extremities of the ribs were now raised without disturbing the heart, and the extreme right limit of the pericardium measured 2½ inches from the middle of the sternum.

Without incising the pericardium it was observed that the anterior surface of the heart—looked at mainly to the left with a slight inclination downwards. There was no pendulum-like rotation; the organ had simply followed the curve of the rib. Anterior border of the right lung covering its anterior aspect in travelling from left to right.

The anterior aspect of the heart was convex. Its left margin extended from the 2nd right-costal cartilage, obliquely downwards and to the left, being separated from the sternum by the distended left pleura. The long axis of the heart was from above downwards, forwards & to the left.

The cardiac portion of the sternum was now completed upward and its right half (disarticulated from the right clavicle) together with the 2nd right-costal cartilage, removed. The bulging of the distended left pleura was now well shown demonstrating how it forms a bulging swelling above, overlying the heart and helping to depress it. Tracing it was now taken.

On reflecting the pericardium, the anterior aspect of the heart was seen to be entirely composed of right ventricle. The interventricular septum looked to the left. If any true rotation takes place it is to the left, not to the right.
The great vessels at the base were entirely displaced, both the aorta and the pulmonary artery being to the right of the sternum.

The pulmonary artery appeared to be flattened between the aorta and the projecting left pleura; it was displaced entirely to the right, being related to the second costal cartilage.

The aorta looked nearly vertical.

It was evident that the above anatomical changes in the vessel (especially the pulmonary artery) might account for the basic recession sometimes audible in left sided affections and the distended right ventricle would also be in part accounted for by the compression of the pulmonary artery.

To investigate the inner surface of the diaphragm, the abdomen was now incised (the stomach was found later). The enormously distended and flattened being made large enough to admit the finger, which was passed through the peritoneum.

The diaphragm in the left side was found to be convex downwards; in the right side (as previously observed from above) it was convex upwards. Hence the entire inner surface as traced from side to side was shaped thus:

\[ \text{right} \leftarrow \text{left} \]

But the central portion of the left epigastrium was consider-
ably more depressed than the parts adjoining its attachments to the ribs anteriorly and laterally so that on the side there was a little bag in which was lodged the upper extremity of the esophagus. The descent of the left side of the diaphragm, as traced from right to left, began at the right margin of the sternum at its junction with the costal cartilage.
The spleen was entirely sub-central, as was also the
depressed diaphragm, neither could have been penetrated
through the abdominal parietes.

The left lobe of the liver was somewhat low, but the right
lobe only extended 3/4 inch below the costal margin.

Experiment No. II:—was a repetition of the above on the body of a
young man who died of erysipelas. The results were similar
to those already recorded. The relations of the right lung to
the heart—before opening the pleura—were confirmed.

Experiment No. III:—a small sheep dog having been thoroughly
anaesthetised with ether—the trachea was severed and the
anaesthetic continued by means of a funnel, tube and
slow cannula, around which the trachea was ligatured.
A small incision was now made (7/2 inch long) exposing
the right intercostal space, half an inch from the sternum.
The skin incision was surrounded with a continuous
suture.

II

A very thin—distensible—india-rubber bag (which was firmly tied
onto a glass tube 7/2 inch long, having a piece of india-rubber tubing
six inches long slipped over its other extremity) was now folded
lengthwise into small compass, and was so passed over the
blunt end of a large probe, that it could readily be inserted into
the pleural cavity when the interface was divided.

III

A minute puncture was now made—through the intercostal spaces,
into the pleural cavity, and this was at once covered with the
fingers. The india-rubber bag was then quickly inflated, and it
clipped into the right pleura (without the entrance of any air)
until the glass tube filled the intercostal aperture. The thin
curette was then drawn tight and firmly tied round the glass
tube.

IV

The chest was auscultated and percussion and the breath
sounds were well conducted on both sides; the note resonant
throughout.

V

200 c.c. of water at 90° were now slowly injected into
the bag, through the india-rubber tube, and while this
was in process the respirations increased in frequency.
The india-rubber tube was then clamped.

VI

On the left side there was a resonant percussion note
throughout, and the respirating sounds were louder and
farther than formerly.

On the right side the percussion note was much impaired
and the vesicular murmurs conducted very poorly, excepting
superiorly where it was louder and more pure.

The heart beat could not be felt on either side, and on the
right it was marked by auscultation by the least breath
sounds.

VII

50 c.c. more water were now injected with great caution (the
chest now contained 250 c.c.) and the tube was again clamped.
The results on auscultation and percussion were unchanged.
A small incision was next made in the epigastrium, through which the finger was introduced to explore the under surface of the diaphragm.

On the left side the arch of the diaphragm was high and the contractions were very vigorous. The heart could be felt beating to the left of the centre of this arch.

On the right side the diaphragm presented a central bulging downwards so that it seemed slightly concave towards the peritoneal cavity, but it became somewhat flattened during contraction, traced towards the central attachments there was a concavity downwards - similar to that observed in the experiments on the human cadaver.

The impression gained by this palpation was that the amount of contraction on each side was about the same (perhaps exaggerated on the left) but that the diaphragm was unable to assume its arched form on the right - owing to the pressure of the experimental fluid. i.e. The contractions were valueless (practically) so far as inspiration is concerned on the dead side.

As a control experiment - the indiarubber tube was now unclamped, and 243 cc fluid escaped - presenting respiratory waves as it did so. The lung therefore had expanded again. This was further confirmed by the return of its breath sounds and
of the resonant well on percussion. The diaphragm was now
arched upwards on both sides and contracting about equally.

XIII

Now, with the finger on the diaphragm—the same quantity of
warm water was again slowly injected and the following
points noted.

(1) The heart immediae travelled somewhat to the left.
If there was no appreciable movement to the left when
about 25 c.c. had been injected.

(2) The right-cupola of the diaphragm at once
began to show less arching upward; therefore injection
became early interrupted, and as the fluid increased
there could be very little air drawn into the chest; since
the cupola of the diaphragm became less and less high and
at last was slightly convex downwards again showing
some flattening during contraction.

(3) The respiratory frequency increased and the
signs of the diaphragmatic contractions seemed greater
especially on the left side. On careful comparison however
there was very little difference in the amount of contraction
in the two sides, but the contractions of the right half were
unable to be effective.

(4) Over the right side the break sounds became
progressively more marked as the diaphragm descended and the
fluid increased.

XIV

The tracheal tube was now clamped and when the animal
was dead, the abdominal viscera were quickly removed
and the peritoneal cavity filled with tissue plaster of paris.