A Thesis

on

Empyema and allied Thoracic Effusions

considered Historically, Clinically, Experimentally

and Practically.

by

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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 not unfrequently 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 (εμπυημα) 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 Actius, 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 unfrequently alluded 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 Hippocratean 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

ippocrates
it B.L. 361
a) art 99.

ancestors, the Asclepiadae, who presided over the temples of health in Greece, and who are the accredited authors of the first book of Prognostics and of the Coan Prognostics which, according to Dr Adams and some other authorities, together formed the basis of the 'Prognostics' of Hippocrates containing so excellent an account of the means of recognising this disease, which may therefore be regarded as one of the oldest known to medicine. As examples of other suppurations which were called Empyemata by Hippocrates, Aph: 10. Sect: V[1] might be cited; where a purulent expectoration from the chest resulting from extension of a disease of the throat to the lungs is probably alluded to. In the 'Prognostics' (parag: 7)[2] the Empyema spoken of seems to refer to a suppuration in one or other hypochondrium, and many other references might be given to show that phthisical cavities 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 succussion for arriving at a diagnosis of this condition, in other words, that he recognised it chiefly when associated with pneumothorax. In his description of pneumothorax, Dr Hilton Fagge,[3] in a footnote making reference to a quotation from the "De Morbis", remarks that the Hippocratic pathology of Empyema consisted in the bursting of an abscess into the pleura as the result of peripneumony. That Hippocrates associated empyema with peripneumony there is no doubt, but it is equally certain that he was able to tell when a chest contained pus without the admixture of any gaseous material; This we know 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'

Translation of the "Prognostics" (paragraphs 16 & 17.).

Prognostics §16. "One should estimate when the commencement of the suppuration will take place by calculating from the day on which the patient was seized with the fever, or if he had a rigor, 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 suppurations. One then may expect the rupture of the abscesses to take place from these times according to the periods formerly stated. But if the empyema be only on either side, one 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 empyema will be upon the opposite side to that on which the weight was felt"

Prognostics 17:- "In the first place the fever does not go off, but is slight during the day and increases at night, and copious sweats supervene, there is a desire to cough and the patient expectorates nothing worth mentioning, the eyes become hollow, the cheeks have red spots in them, the nails of the hands are bent, the fingers are hot especially their extremities, there are swellings in the feet, they have no desire for food and small blisters (phlyctaenae) occur over the body. These symptoms attend chronic empyemata and may be much trusted to; and such as are of short standing are indicated by the same, provided they be accompanied by those 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

at the commencement and if the dyspnoea, cough and ptyalism be severe, the rupture may be expected in the course of twenty days or still earlier, but if the pain be more mild and all the other symptoms in proportion, you may expect from these the rupture to be later, but pain, dyspnoea, and ptyalism must take place before the rupture of the abscess. Those patients recover most readily whom the fever leaves the same day that the abscess bursts; when they recover their appetite speedily and are freed from thirst, when the alvine discharges are small and consistent, the matter white, smooth, and uniform in colour, free from phlegm and if brought up without pain or strong coughing. Those die whom the fever does not leave, or when appearing to leave them it returns with an exacerbation; When they have thirst, but no desire for food and there are watery discharges from the bowels; when the expectoration is green or livid, or pituitous and frothy; If all these occur they die, but if certain of these symptoms supervene and others 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 rupture mentioned does not refer to the bursting of an abscess into the pleura as stated by Fagge & others, but to its bursting 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 cured*: and this too accounted for the frequency of the occurrence of pneumothorax in

* The same thing is surely to be understood in the aphorism No 15. Sect V:— Persons who become affected with empyema after pleurisy, if they get clear of it in forty days from the breaking of it, escape the disease; but if not it passes into Phthisis.

these days and for the employment of succussion as a sign of Empyema. But if this expectant line of treatment was commonly adopted there are also evidences that operative measures were had recourse to; There is little said about the operations themselves in the books known to have been written by Hippocrates, he merely makes mention that "when empyema is treated either by the cautery or incision, if pure and white pus flow from the wound, the patients recover, but if mixed with blood, slimy and fetid they die". (Vid aph 44. Sect VII. (4) & Prognostics parag: 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 objects; The practitioners of that time seemed to recognise that the letting out of the pus was a successful means of treatment, (5) and mention is made of it as a means of safety and one to which prompt recourse should be had; (6) 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 serous or purulent, (7) which, as explained by Galen they supposed to cause "a fatal loss of the animal and vital spirits". (8) The operation as 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 lung, 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 III - 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

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 feet and the cough;[9] then, in order to ascertain which pleural cavity contained the pus, the chest was surrounded with a napkin which had been dipped in hot water containing vermilion ("rubricâ liquidâ") thoroughly ground, and whichever part of this dried first, indicated the position in which the incision with knife or cautery was to be made.[9] It may be well to mention here that in the second book of the Dr Morbis it is recommended that the opening be made in the side which is most swollen and most painful, low down rather than in front (i.e with the patient on his back) in order that the pus may escape more easily,[10] a remark which proves the antiquity of the surgical principle of making an incision for drainage at the most dependant part; and another most interesting historical point is the observation that when the pus was thin (watery) a pewter drainage tube was to be introduced[10] – which was gradually shortened to allow the wound to heal. When the knife was used, in one book of the Dr Morbis (Lib II) 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 subjacent parts were to be perforated with a pointed knife, guarded by having a piece of rag so wound round it that only a portion the length of the thumb nail remained exposed.[10] On reaching the pus some of it was allowed to escape, and the incision was

then plugged with a stiff linen tent tied 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 & oil was injected through the fistula. As before
noted, much importance was attached to the gradual evacuation
of the pus by the Hippocratean 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
rib (after making an incision through the skin) with a sharp trepan (11)
so that they might have a rigid structure to cork and uncork
so to speak, as they found necessary

The writings on medicine during the five centuries which succeeded
the Hippocratic era do not appear to indicate any change
either in the methods of diagnosis or of treatment detailed
ms. A.D. 30. above, Celsus makes no specific mention of empyema
in his writings on peripneumony, but in his chapter on
fractures of the ribs (Lib VIII. Cap IX.) he refers to suppuration as
a complication; He however does not make a very clear distinction
between what might be a costal 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 no external swelling, he instructs
that the part is to be smeared over with Cimolian Chalk
(probably Fullers Earth) and that at whatever spot this remained
longest moist, the pus would be most superficial and that the

cautery should be inserted there. This it will be noted is contrary to the experience of the Hippocratic writers, who state that the pus is to be found where drying (of the mixture of vermilion and water) first occurs; a difference of opinion which would seem to indicate that the method was somewhat unreliable. The reasons for thinking that Celsus here referred to empyema are, that he alludes to this absence of external swelling, and to the necessity for nourishing the body after the operation, "to prevent a tabes which would prove fatal", and furthermore he states that in some cases "instead of pus there is an internal collection of a fluid like mucus" i.e a serous effusion.(12).

Galen: Born A.D 130 Died about A.D 200

Galen added nothing of importance to the knowledge of this disease; he appears to have favoured perforation of the bones, as exemplified by his well known brilliant case of mediastinal abscess (called empyema) in which he removed a portion of the sternum, laying bare the heart, and so giving issue to the pus; but that he recognised true empyemata is evident from the manner in which he records his practice of injecting honey water through the ulcer, and having shaken the patient well, of placing him on the affected side to allow the fluid to escape, to favour which the sick man 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 material change had taken place either as regards the modes of recognising empyema or the means adopted for its relief and I have related the former somewhat in detail because they became traditional, the teachings of Hippocrates having been handed down practically unchanged from century to century until

the more refined clinical methods which were made known by the discoveries of Auenbrugger and Laennec came into use. But the treatment of this ailment has gone through many and various changes, which have depended in part upon modifications in surgical 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 or seventh centuries, when Thoracentesis seems to have become unpopular; a key to this is furnished by Paulus Aegineta who says "Others, as Leonidas says, having passed a knobbed cautery, heated in the fire, through the interstice between the ribs to the abscess, having carried the burning down to the pus. Some have dared to operate upon them by making a transverse incision, or one a little obliquely in the skin between the 5th & 6th ribs, then perforating with a knife the membrane lining the ribs, and thus evacuating the pus; but they and those who burn with iron to a considerable depth either occasion immediate death, the vital spirit being evacuated with the pus, or occasion incurable fistulae".(14) Aetius, 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 eschars by means of the actual cautery, presumably in the hope of causing absorption by this counter irritation. This practice also extended itself among the Arabians, as noted in a commentary on the above translation by F Adams. who mentions that Haly Abbas(15) and Rhases were accustomed to recommend it, although the latter seems also to have practised paracentesis by means of a small aperture, to allow of slow evacuation of the fluid. For this super-

Paulus Aegineta. end of 6th or beginning of 7th century

Aetius: 6th century.

ficial cauterisation. The root of the long birthwort (aristolochia) dipped in oil, and set alight, was frequently employed (as noted by Paulus Aegineta) in preference to the hot iron.

From this Arabian period up to the sixteenth century there were not many writers who advocated operative measures, and those who ventured to open the chest followed the Hippocratean directions; the only differences of opinion being as to whether it was better to use the knife, or the cautery, or a combination of a caustic, which produced a superficial eschar, with the knife, which was subsequently employed to complete the perforation of the soft parts; the advantage claimed for this latter method and for the actual cautery over the simple incision with the knife probably having been that the seton was less likely to heal too quickly.(16) But during this period operations for the relief of intra thoracic effusions - of whatever nature - the result of traumatism (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 these cases, simply to dilate the original wound or to make a counter opening; some writers advocating this latter as a rule - where signs of effusion followed a wound, and the former in every case in which penetration of the thorax had occurred, to afford a sufficient vent for blood, or for pus if any subsequently collected.(17) 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 intercostal

on account of the dangers of injuring the diaphragm in the former[17] and Salicetus and Dr. Chauliac add the further precaution, that care is to be taken to avoid the origins of the nerves.[18] 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 ancients

The next stage in the history of our subject, began during the latter half of the sixteenth century, when once again, despite considerable opposition empyemata 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 Ambrose Paré's article on Empyema, that he was unfavourable to interference with the viscous structures because of the difficulty of making certain that the flow would 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 but Paré also made use of the 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.[19] At this period

Paré 1579.

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 Marcellus Donatus and Fabricius of Aquapendente, who both regarded operation as the only safe means of treatment, 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 5th interspace, four or five finger lengths away from the sternum was the most suitable site for incision, thus avoiding the thicker muscles further back; but he also described a method whereby the point of puncture might be determined by measurement, the length of the sixth rib being taken with a thread, and the point chosen being distant one third of its length from the sternum. Here he made his incision, parallel to the direction of the fibres 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 perforating the chest he directed the patient to make an inspiration (Vid page 139 20a) in order that the diaphragm might be protected. Both Marcellus Donatus and Fabricius made use of cannulae 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. (20)

Donatus 1588.
Fabricius of Aquapendente 1617.

Early in the seventeenth century we find for the first time that some attempt was made to break through the traditional practice of keeping

an empyema open for a prolonged period by means of tents or cannulae. It was noted that cases of penetrating wounds of the chest sometimes got better sooner when allowed to heal early, and it was argued that it might be advantageous to allow the sinus in empyema to close early also. This view was supported in a very sensible way by Gregorius Horstius (and by Fabricius Hildanus in a commentary in his questions) who opposed the prolonged keeping patent of all wounds of the chest, without distinction, unless a copious suppuration indicated it.(21) But evidence is not wanting that errors were made in the direction of allowing these penetrating wounds to cicatrize too soon; Marchettis recorded a case of this description, in which he reopened the scar and so relieved the empyema which had formed.(22) But perhaps the most important suggestion in this century emanated from Bontius, who, I think must have argued that since the spontaneous evacuation of the pus 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 his opinion the trachea was the only natural channel of exit for the pus, but when this was insufficient, he freely opened the chest, between the 4th and 5th ribs, employing the plan of making a superficial eschar with the potential cautery in the first place, and subsequently puncturing this with a knife, thus ensuring a large aperture, which would not be likely to heal quickly. But although Bontius had cases which were successfully treated by this method, and in which no care was taken to exclude the air,(23) he was ahead of his times this suggestions met with opposition, for instead of less care being taken to prevent its

s Horstius 61.

ellis

ius 1629, p. 9

early, practitioners seem to have begun to consider other measures
in 1663. for avoiding it; Bartholin[24] for instance, thought every care should
be taken to prevent contact of the lung with the air, and that the
opening should be speedily 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 tent,
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 empyema it is frequently
stated that the use of syringes for the purpose of withdrawing
pus from the chest, and so preventing the contact of air with
1669. the lungs, dates back to the time of Scultetus, most authors
quoting this observation from Sprengle (Hist: de la Médecine Tome IV
page 23) I have only had access to one copy of the Armamentarium
Chirurgicum (Ed Amstelodami; apud Joannem à Someren, Bibliopolam sub insigni
Perkins, 1672.) and in it can find no evidence that Scultetus used
syringes for the abstraction of thoracic effusions, although he frequently
refers to their use for making injections into the pleural cavity
after thoracentesis. At page 33 Tab XIII. parag I. he refers in general
terms to the use of the syringe both for extracting and injecting purposes,
but nowhere can I discover that the chest is specially
mentioned in the former connection. Scultetus however mentions
the use of the syringe for throwing fluids into the chest
which would not only prevent the lungs drying 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 thin in consistence

in which case it was sometimes allowed to remain in situ, and was plugged with a tent in the intervals between the injections.[25] The leaden cannula came to have a good many advocates about this period and appears to have been preferred chiefly on account of its flexibility being easily bent into various curves. Hey, when writing upon this subject at the end of the eighteenth century, refers to his use of the leaden instrument; making its tube adapt itself to the shape of the wound, a detail which must 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 (Vid. Ruck. Op. cit. Chirurg. p. 111)

There is little else of interest to record in the history of empyema in the 17th century beyond the circumstance that the use of the cautery for performing the operation became much lessened as did also the perforation of the ribs or sternum, but it must be noted that Dionis in 1694. first made general use of the trocar, inserted between the third and fourth ribs, for the relief of empyema and hydrothorax in 1694,[26] a practice which was supported by Dionis[27] and Rüeh[27a] who stated that he did not see why it should not be used in thoracic as well as in abdominal effusions, and he pointed out that the needle 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 elapsed

as we shall presently observe.

About the commencement of the eighteenth century one more attention began to be chiefly redirected 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 parietes, had been greatly due to their observations of these cases; as an important example of this the idea of removing fluids from the chest by means of a large syringe may be cited, and it appears to have originated with Anel, who in 1707 invented a machine for pumping out the thoracic cavity through cannulae 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.[28] Anel 1707.

De la Motte 1722. De la Motte, who wrote about this time inferred that it was customary to be accompanied at every duel by a professional "sucker" (a quack), and that the results of this treatment were sometimes so fortunate that many people attributed them to the devil.[29] "He had seen one of these professionals after sucking 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 to his affairs." De la Motte however disapproved of suction in these cases on account of the danger of increasing the hoemorrhage, and in most of his "observations" which I have read, after attempting to get rid of the blood (or in one case blood which

had become purulent) by making the patient hold his breath or cough, he drew off the effusion with a hollow sound.

1748. Heister was another upholder 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 expansion of the lung.(30) This author as well as De la Hostle pointed out the importance of making a counter opening low down, in cases where the chest was wounded high up, and in which effusion had occurred, and both of them mention the necessity for having a chafing dish of hot coals held near to the wound to warm and thin any air which might be drawn in.(30) In cases of empyema proper, Heister preferred to incise the superficial structures and afterwards to perforate the pleura with a trocar, whilst De la Hostle 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.(31) It was about this time too that another observation was made, which like the abandonment of injections by De la Hostle was opposed to the teaching of Hippocrates; I refer to the

...ner 1715. statement of Brunner who in 1715. remarked that an icherous pus did not always necessitate a fetid issue.(32) 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, namely, 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 sanguineous 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 hæmorrhage and that if coagulation had occurred the clots would be unlikely to escape through the wound;(33) 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 of the pulse) indicated the cessation of the hæmorrhage. If the blood remained in a fluid state, the patient having been placed conveniently was instructed to hold his breath and force the blood out, but if clotting had taken place, aspiration was had recourse to by means of a syringe; the wound was dilated if need be, and fluids were injected to assist in the evacuation by dilution and breaking down of the clots.(34) Various pumps were recommended to favour these measures, one invented by Brender was introduced by Ludwig in 1769. He advised the evacuation of all the fluid at one time unless the person entrusted with the performance of the suction was inconvenienced by the least

1750.

Swieten 1745-2

disagreeable odour; another similar instrument was suggested in 1770 by Leber, simpler in construction and not requiring the application of the mouth, but Richter pointed out that these appliances were not serviceable, because if the blood remained fluid it would escape of itself through the wound, and if clotted it could not be pumped out.(35) 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 passed round the rib by means of curved needles. Gerard about 1740. appears to have introduced this method;(36) He employed a curved needle furnished with a thread, to which was attached a ~~pledget~~. The needle having been passed round the rib and out above its superior border, the thread was pulled upon until the ~~pledget~~ attached to its inferior extremity pressed against the inner surface of the rib, then the thread was tied over a thick external compress. Somewhat later Goulard improved upon Gerard's method, by making use of a needle having a handle.(37) The curve of the needle was such that when inserted at the upper border of the rib - the handle pointing downwards - it was made to encircle the inner costal surface, & project at its lower border, by simply pairing the handle, The thread was then siezed and the needle withdrawn by again depressing its handle. To the inferior extremity of the thread a large pledget was then attached - a little incision through the muscles being made to allow of its entry, it was drawn

into position by pulling upon the other end of the thread, which was fixed to a compress. Both Gerard and Garland incised the skin before inserting the needle, the advantage claimed for the needle having a handle was that it involved less risk of wounding the lung or pleura; Another method of arresting internal hoemorrhage introduced by Lotteri of Turin[37] consisted in the insertion through the wound of a spoon shaped instrument, bent at one end & having a post attached - which was applied against the inner surface of the rib, the free extremity of the instrument being fixed down by a bandage round the chest. Lucas may 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; then Belloc invented a special tourniquet consisting of two plates which could be brought together after introduction of one of them into the chest.[38] These various methods or the simple application of astringents were relied upon with little modification until early in the 19th century when Scarlini (1812) expressed his opinion that the best way of stopping the hoemorrhage was to complete the section of the vessel, and trust to its retraction rather than run 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 ended in suppuration, and their treatment might be regarded as preventive of Empyema. The other point which I have mentioned as having received renewed attention at this time, was the admission or expulsion of air from the chest after operations for thoracic effusions; It was Henry Bass who, about the year

1717 first made the attempt to exclude air by means of a valvular opening[39] – which he effected by making the cutaneous incision at a different level from that in the pleura – so that after the evacuation of the fluid, the orifice might be closed by retraction of the skin; a practice which has had its advocates until a comparatively recent date. (Vid Ch: Bell 1807. Spences Surgery. Ed 1876). Lurde, in 1765 improved upon this method by again making use of the trocar, and by placing the finger on the orifice of the cannula during each inspiration so that air could not be drawn into the chest;[40] but although this appeared to be a great advance, and must have been successful in some cases of hydrothorax, its obvious disadvantages in empyema evidently became apparent, for we find Chopart and Desault ten years later abandoning its use and resorting again to simple incision,[41] and in 1778, Hemmann expressing the opinion that it was useless to take precautions for the exclusion 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 he spoke of making the patient take a deep breath as an alternative. This method of favouring expansion of the lung, or as it was then designated, of expelling the air, was also practised by Van Swieten,[42] 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 endeavoured to expel it when the cavity had become empty of liquid; Then, holding the lips of the wound together with his fingers, he made the patient take a long breath – opened the wound and closed

it again before expiration took place — and having repeated this process several times, the sinus was at length sealed with sticking 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 before the minds of these practitioners, was the advice of Morand, (431) c 1750. 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 arched 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 (Chopart & Desault), but if when operating at a seat of election, it was found that an adhesion was come down upon, and that the fluid was issued 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 frequent 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 prove that the diagnosis was often missed altogether, and that the

symptoms required to be very pronounced to allow of its being with certainty recognised. It may be interesting if I mention the opinions of some of the men of these times, which will indicate what I have just observed.

Samuel Sharp F.R.S. Surgeon to Guys Hospital in 1750.[44] considered that the species of empyema where the lungs adhered to the pleura, so that the pus produced an external swelling, was most common, and that the true empyema (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 on 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 recognised, and of all the classic signs (E.g. dilated side, decubitus, oedema of skin &c namedby every author) he placed greatest reliance upon the preternatural expansion of the side of the chest.

Joseph Warner[45] who was cotemporary with Sharp at Guys Hospital records three very striking cases treated by incisions which were subsequently kept open with tents; One of these was fatal, the diaphragm having sloughed through so that the liver was eroded, but the other two were cured, one in six, and the other in five weeks after being operated upon. Warners cases illustrate the point that the disease, in his time, was generally far advanced before being recognised. The fatal one was under

observation – and was repeatedly bled, to relieve pain and dyspnoea – for several months before it was incised; the second case had become an empyema of necessity, and the remaining one, a man aet 27, who had been ill for three weeks before his admission to hospital, was not known to have empyema until he had been in the wards for about three weeks. In his annotations in these cases, Warner remarks that he considers immediate operation imperative, and that it should not be deferred in expectation of the fluid being absorbed into the circulation, and evacuated by the urine, stool 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 finger into the pleural cavity to seek for adhesions – and I have no doubt that their absence, which was recorded in every instance, was regarded as a favourable prognostic for I observe that Le Dran, (46) who was a great authority at the time, and is generally quoted by authors of the period, says in his chapter on Empyema "that (Empyema of pus) which proceeds from a suppuration in the breast may be cured by an operation if the lungs do not adhere to the pleura; but if they do, and if the pus which was enclosed in a cystis happens to be dispersed upon the diaphragm, there is very little to be done in such a case". Le Drans descriptions of the physical and vital signs of the disease do not differ materially from those enumerated 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 adhesion of the lung.

to the mediastinum, the patient may be able to lie on either side, because when a cyst, gradually filling with matter is situated between the mediastinum and the lungs, it causes the mediastinum to yield so gradually that "habitude becomes a second nature", whereas, where there are no such adhesions, the lying on the sound side causes so sudden a weight to be thrown on the mediastinum that the unusual pressure of fluid occasions distress to the other lung. This explanation of the cause of this symptom was disputed in 1808 by Richerand,[47] who made experiments to show that patients could not lie on the sound side because this interfered simply with the expansion of that side of the chest, and was not related to pressure on the mediastinum. To prove this he injected fluid into the thoraces of several dead subjects, through an intercostal opening (taking care that no adhesions existed) and when from three to four pints had been introduced, the ribs and lungs were removed from the opposite side, and the mediastinum could be distinctly seen reaching from the vertebrae to the sternum, and supporting without yielding, the weight of the liquid, in whatever position the body was placed. But subsequent authorities claimed that this explanation was erroneous, on the ground that in many cases, after evacuation of the liquid - a patient can at once lie on the sound side, although the lung remains unexpanded, and the muscles of the sound side are still depended upon for the performance of respiration, and Townsend[48] pointed out in support of this, that in cases of empyema following pneumothorax, the patient can generally lie on the sound side, so long as the collection is chiefly gaseous, but that the dyspnoea increases pari passu

with the increase in the amount of liquid effused.

Hey[49] in 1803 recorded an interesting case illustrating the fact that recovery may ensue when the chest contains enormous quantities of pus. Five ale pints were evacuated and the patient afterwards wore a leaden cannula for fifteen weeks, and eventually became quite well. Hey regarded the oedema of the affected side an important symptom; in this case (which by the way resulted from Influenza - then prevalent) it extended to the face and eyelid.

Charles Bell (1807)[50] after detailing the usual symptoms refers to the advisability of incising 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 good and the collection local, patients often sink; he also points out that where matter has been expectorated the cavity of the chest is diminished and the diaphragm rises very high; in one such case a post mortem showed that had he opened in the 6th interspace, he would have entered the peritoneal cavity. He made use of a trocar after dividing the intercostal muscles, in order to satisfy himself as to the nature of the fluid, for 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 thoracic effusions to escape a little at a time, had remained in force; there were surgeons

who made occasional exceptions to this rule in their practice, but the principle remained unchanged; At this date however Andouard (51) asserted that the sudden withdrawal of large quantities of fluid was not liable to be followed by such harmful 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 pus withdrawn at one time.* There is a very full & interesting record illustrating this point (although the patient eventually died) in Baron Larrey's Memoires de Chirurgie Militaire: (Tom III. 1812), (52) that of a young soldier — Tambour des chasseurs de la garde — who after an attack of pleurisy (April 1802) complained for some time of a pain in a particular part of his side, when he underwent violent exercise, associated with shortness of breath, palpitation, and gradually increasing weakness; until on account of threatening suppuration he again entered the hospital in May 1804. His left chest was found to contain pus, which spurted out to a distance of more than four feet on the intercostal space being incised. It was all allowed to escape, and the amount was estimated at from five to six litres. The operation was followed by no syncope or other ill effects, on the contrary there was great relief to the respiratory distress and the contractions of the heart appeared to take place more easily. After going on satisfactorily for some weeks, he was one day suddenly siezed with rigors, stupor, oppression, difficulty of respiration and colic, the result of exposure to cold; having been

* Another observation made by this author is worthy of mention:- Recognising that in cases of Empyema the thoracic organs are in a debilitated condition, he considered that the entrance of air after operation was likely to be rather beneficial than otherwise, and that on account of its tonic effect, it would stimulate the absorbant power of the pleura and hasten the production of those organic adhesions between the visceral and parietal surfaces, by means of which nature in fortunate cases obliterates the cavity. This recommendation was not favourably received or commented upon by subsequent authorities who although admitting the impossibility of absolutely preventing the entrance of air, were of opinion that it was very irritating, that its access should be as limited as possible and that what did pass its way into the chest cavity should be modified as regards its temperature & humidity. Andouard named this ingress and egress of air, which took place during the early days after the operation "respiration illégitime"

found uncovered on a very stormy night; and in spite of vigorous treatment he afterwards rapidly wasted – with hectic – 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 he 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 tents, 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 cure.

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 result of left sided pleuritic effusions were probably only beginning to be clearly recognised and that the value of this sign for diagnostic purposes was as yet uncertain. This patient was in the first place admitted into the medical wards under M. le docteur Sue who quickly recognised that the heart was beating on the right side, and he inferred 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 on the right side of the chest, at the siege of Saint-Jean d'Acre. 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 transposition by constraining the hearts action, was deranging the circulation. The case on account of this displacement of the heart, excited much curiosity among the pupils and many of the practitioners in the town, and it was not until Larrey recognised that there was thoracic effusion on the left side that the nature of the

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 on the 15th day, and at the post mortem examination it was found to be so bound over by adhesions that its apex pointed downwards 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 small, the walls of the latter being almost in contact — all of these conditions were held to account for the diminished peripheral pulsations both before & after the operation {The post mortem report states that there was also a patent foramen ovale and ductus arteriosus}. In addition to there being an absolutely collapsed lung, it was further discovered that the sterno costal junctions of the 7th & 8th ribs were carious — probably the result of the blow from the stone before mentioned — and to this was attributed the pain complained of before his admission into the hospital for the second time as well as the thoracic effusion itself. Larrey makes no mention of contraction having taken place in the side in this case although he refers to this subject in his Memoirs.

This 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 first observed about this period. It was however only recorded as occuring in left sided effusions until about the year 1833, when Dr Townsend (53) 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 spoke of these dislocations, since they seldom arise from any other cause as being "the most constant and least equivocal of all the signs of effusion".* Prior to this time

* The dexiocardia due to drawing of the heart over, after contraction of the right side, was described by Stokes.

The cardiac displacement was spoken of as being rather occasional in its occurrence (even when the empyema was in the left side); Cooper mentions it in this way, and comments upon a post-mortem which he saw at St Bartholomews Hospital - where there was a large left empyema in which the heart had been noticed pulsating to the right of the sternum, but the diagnosis had been missed, and some had thought it was a case of aneurism; a mistake which was not without precedent, for Le Roy (54) in 1804 observed that in empyema the movements of the heart and thoracic vessels frequently gave rise to an aneurismal appearance; but some of the cases referred to were probably instances in which pulsations were transmitted to those localised bulgings occurring in empyemata pointing externally (pulsating empyema of recently). Such a case is mentioned in the Dictionnaire des Sciences Medicales where in the left side posteriorly there was a swelling having all the appearance of an aneurism due to the pulsations being transmitted through the pus. The transmitted pulsation observed occasionally in the intercostal spaces when the chest is full of pus was first described by Fretean (55) and it must not be compounded with the "fluctuation" in the spaces, which together with a sense of resistance had been relied on as confirmatory signs for some time previously, although Trousseau lays claim to the credit of first observing the former (56.) He discovered this sign accidentally, when percussing with the plexmeter and hammer - the impulse being transmitted each time he struck the plexmeter to the hypothenar 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 space while

be percussed. In 1813, Bichat[57] endeavoured to establish an aids to diagnosis by means of abdominal pressure; he thought that by pressing upwards from the hypochondriac regions 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 practised 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 doing most of the work.

The revival of the discovery of Avenbrugger (1761) by Corvisart[58] which took place about this period (1806) had a very different bearing upon the diagnosis of thoracic effusions, for it speedily 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 recognised. To distinguish liquid from other causes of dullness the patient was examined in various postures (much as we now examine a case of ascites) and by observing whether the dullness disappeared from a dependant part when this was made superior in position. It is not surprising however that we find it noted that the results of percussion were often untrustworthy and had proved fallacious on many occasions, when we consider that the levels of pleuritic effusions often fail to be altered by changes of bodily posture, even when they are moderate in amount,

and it would therefore, even in the presence of some of the other more known signs, have been often impossible to say whether the dullness was due to fluid or not. Hence, although a great advance was made by the recognition of this dullness on percussion, which is at the present day perhaps the most reliable of the cardinal signs of thoracic effusions, 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 those 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 Piorry (59) contributed much to this improvement when he introduced Mediate Percussion by means of an ivory plessimeter in 1828. Prior to this time no plessimeter was used, the ribs or interspaces being simply struck with the ends of the fingers or sometimes with the flats of the fingers. Piorry's modification of Corvisarts method greatly enlarged the field of physical diagnosis, and afforded a means whereby the anatomical limits of organs, both normal and abnormal, as well as of pathological effusions might be determined. His motto on the title page of his book is "un organe étant donné, chercher à déterminer pendant la vie sa disposition physique". When we consider the more limited utility of immediate percussion, I think Laennec's observation which I quote from

the introduction to his book might well have been deferred until auscultation had been established; He says (page 3. Forbes' translation) "I say I will go so far as to assert, and without fear of contradiction from those who have been long accustomed to morbid dissections, that before the discovery of Auenbrugger, one half of the cases of peripneumony and pleurisy and almost all the chronic pleurisies were mistaken by practitioners"; for I do not think we can assert that the accuracy of diagnosis had become very much more assured until Laennec had added his own discovery to the one above referred to, and it cannot be said that much advance in the physical diagnosis of emphysema and other intra thoracic affections has been made since he published his work,(60) (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 practically unchanged 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 follows.

1. The rapid increase of the dullness on percussion (distinguishing from peripneumony).
2. The intensity of the dullness 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 conduction where adherions exist, and the frequent bronchial character of the breath sound.
4. The puerile breathing on the sound side (in chronic cases) and its occasional conduction to the diseased one

5. The frequent long duration of the indistinctness of the respiratory sounds and of the dullness on percussion after absorption has taken place, due to the presence of false membranes.
6. The appearance, disappearance and return of œgophony. Its limitation to moderate effusions and its value as a diagnostic of the presence and amount of the outpouring. 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 (reappearance of the breath sound from above downward, and of the œgophony &c).
8. The precise description of the contracted chest following absorption of the fluid. *

&c. &c. &c.

Although Laennec did so much to place the diagnosis of this disease on a more certain footing he made no suggestions of importance regarding its treatment, and indeed many years elapsed before any improvement in this respect took place. As an early measure he recommended a succession of small bleedings; blisters, caustic issues or setons to the side; tonics, antisiorbutics and diuretics being given internally; But when a very copious acute effusion occurred, which threatened to suffocate the patient in a few days, or when in the chronic form every other means had proved unavailing, and the oedema, emaciation and debility threatened the patient, he advised operation, although he regarded it as seldom successful, either on account of the tuberculous state of the lung, or because that organ having been

* Pleuritic fluctuation was not observed by Laennec: It was discovered by Reynaud "Sur l'auscultation de la poitrine" Journal Hebdomedaire de Medecine Tome. 1829.

so long compressed had lost its elasticity, and could not expand to the normal extent, so that the long continued suppuration gradually exhausted the patient. Laennec did not recommend the trocar because the chest refilled after withdrawal of the pus, although he thought it might be serviable in the acute empyema, (not necessarily purulent). He preferred thoracentesis and prophesied that early operation would probably become popular - as the effusions became recognised sooner, owing to the expansibility of the lung being less interfered with, and it is interesting to note that he suggested the use of an exhaustion glass - applied over the wound - after evacuation of the fluid to cause a vacuum in the chest cavity and thereby aid expansion of the lung., an idea which had however been thought of previously by an anonymous french writer (quoted by Sprengel) who advised the application each day of cupping glasses over the wound - a proceding which was deprecated by Severinus (de Efficaci medecina: Ed: Francof: 1646) on account of its cruelty.(60) This principle was again suggested by Mr Towell of Nottingham in the Medico Chirurgical Review for 1826. He relates the case of a girl in whom he allowed the wound to close by the fifth day, with the result that much 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 empyema again pointed and burst at the seat of incision on the 25th day, after which the patient gradually recovered, the chest at first being much contracted, and the spinal column curved, but eventually this improved and was much less perceptible six months later. Mr Towell attributed much of the danger of

thoracentesis to the entrance of air, and thought it necessary to exclude it because it simply substituted a gaseous for a liquid compressor and because it gave rise to decomposition (which in turn was another source of gaseous accumulation). On these accounts he suggested as a substitute for incision, the introduction of a small trocar, to the canula of which he would attach a tube connected with a Kreid's or Weiss' syringe through this he proposed to withdraw the pus, subsequently removing the canula without detaching the tube, and then sealing the wound with plasters and a compress, to prevent it being forced open by coughing.(62) I have not been able to discover that Dr Twells plan was ever acted upon, although it was probably the nearest approach to true aspiration which had thus far been proposed. During the fifteen years which succeeded the publication of Laennecs 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 noticable that at first the disease was very often recognized before the stethescope was employed, and that it was then used as an additional means of diagnosis, and so at length its use in this way became confirmatory of its own utility. Some books, more especially the surgical ones make no mention of auscultation as an aid to diagnosis, for instance Coopers Surgical Dictionary, a classic work,* describes all the older signs of the disease, including percussion, but omits the stethescopic signs, and states that the symptoms altogether are very equivocal and the existance (i.e. the diagnosis) of the disease somewhat doubtful. The

*1825.

medical writers, however, generally described them.

I have omitted hitherto to refer to vocal fremitus in its historical relations, owing to the fact that although it was known to Laennec, (having been described in 1819 by Reynaud (63)) he did not esteem it a valuable sign, and we find no mention made of it even by the best writers after his time, until Hudson independently directed attention to its value in this country; his observations being published in 1833 by Stokes of Dublin and since then it has always been regarded - negatively - as one of the cardinal signs of these diseases. (63)

To Stokes is due the credit of asserting that the intercostal muscles and the diaphragm became distended not so much on account of the pressure to which they are subjected by the accumulated fluid, as because they become paralysed owing to an inflammatory action, much in the same way that a bellows becomes distended when inflamed, and in support of this view, he directs attention not only to the feebleness with which the muscles act after absorption of the fluid, but also to the circumstance that non-inflammatory conditions causing distension of the chest, such as hypertrophy (Laennec) emphysema, & enlargement of the liver, do not cause flattening and loss of tone of the intercostal spaces, and finally he points out in further proof of the paralytic nature of this phenomenon the circumstance that in some cases of Empyema the diaphragm, after retaining its convexity up to a certain point, suddenly yields, (64) without any increase in the amount of fluid effused. He considered that protrusion of the intercostal spaces was a sure sign of the purulent nature of an effusion - an observation which has the support of many modern writers, although it was denied by Walsh. Stokes also directed attention in this connection to the

displacement of the liver which he had observed in 1822, and to the reputed depression of the spleen, of which he had had no personal experience; but he was by no means the first to discover these hepatic displacements, for they had been previously described, but had nevertheless been frequently mistaken for enlargment of that organ, as exemplified in a quotation by Townsend from a memoire by Roux, relating a case pronounced as an incurable enlargment of the liver, which proved to be a depression of that viscus, disappearing when paracentesis was performed by Bichat. Copland (15) (Med: Dict: - article Peripneumonia Pleuritis 1858) considered that the liver was frequently enlarged in emphysema apart from any displacement, — an observation which he claims to have made so early as 1815 — owing to its undertaking a vicariously increased function to remove impurities from the blood, which would accumulate, on account of the impeded action of the lungs; and he also points out that it is frequently congested and thereby still further enlarged, in the more chronic cases of emphysema, owing to the circulation in the lungs being interfered with and thereby causing backward pressure. I might here mention that the difficulty which sometimes existed in distinguishing an enlarged liver from a right-sided emphysema was known to writers of the 17th & 18th centuries, and not a few cases of abscess of the liver had been operated upon in mistake for this disease (Le dran. Morand v. a.).

There remains one physical sign and one clinical method to mention in the historical part of this essay - namely: - the tympanitic resonance heard in moderate effusions, on percussion underneath the clavicle - which was pointed out by Skoda about 1850. It is very useful as a confirmatory sign although not always absent in pneumonia. The method to which I prefer

was the employment of the grooved needle for puncturing the chest, as a means of distinguishing between serous and purulent effusions; It was introduced by Dr Thomas Davies in 1835 and was very generally employed until supplanted by the hypodermic needle, first recommended for this purpose by Kinger.

As regards treatment:- until Laennec published his memoire advocating the performance of paracentesis in all cases of considerable effusion (1843 + amplified in 1868) the universal practice was to trust to bleedings for the purpose of arresting the causal inflammation, and to diminish the amount of blood passing through the compressed lung. Local derivatives were applied in the shape of cataplasms and (after the subsidence of the fever) blisters or the application of the moxa. Internally it was customary to give mercury and Iodide of potassium, diuretics and low diet. (a quotation from Bronssais being sometimes alluded to "the more a patient eats the sooner will he die.") All of these remedies were intended to keep the vascular system as empty as possible, in order to render it likely to absorb the effused liquid. By these means simple effusions were expected to subside, and Stokes 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" he says "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) operation, whether performed with the trocar or by incision, was regarded as a dernier resort, never to be

had recourse to unless the life of the patient was threatened, and even where known to be purulent – derivative remedies were by many employed for long before the operation was ventured upon. The principal fear in connection with the removal of a serous effusion seems to have been that the entrance of air might convert it into a purulent 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; to Prof: Schuh's invention of a small trough fitted with a valve, which could be affixed to the canula after withdrawal of the trocar, and to Reybards simpler idea (66) (1841) of making a valvular opening to the canula with a piece of moistened gold beaters skin. In cases already purulent most of the best authors agreed with Laennecs edict 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 1841. perforation of a rib was revived with success by Reybard, with the object of affording a rigid support for the canula which be inserted through the hole and retained it there as a drainage tube.

Dr C. J. B. Williams (Path: & Diagnosis of Dis: of Chest. 4th Ed. Lond 1840) recommended repeated tappings of the chest in Empyema, and also the displacement of the pus with water, which be injected through a double tubed cannula, his idea being that the water would, like a serous effusion be capable of absorption, but if after repeated tappings the matter still continued to form, he employed weak solutions of nitrate of silver or of Sodium chloride! (67) In later years

some mention is made of chlorinated solutions, especially where the discharge had become foetid, and Trousseau was particularly fond of injecting iodine under similar circumstances. As already stated, Trousseau in 1843 announced his belief in the removal of serous effusions with the trocar in the ground that, contrary to the teaching of Louis (who regarded them as never fatal) they were liable per se to cause death; In his lectures (Syd: Soc: Vol iii) he furnishes an additional reason for this practice in the fact that serosity effused as the result of inflammation of the pleura is likely to undergo a transition into pus, (i.e the later secretion is liable to be purulent just as the later secretion of a bronchial catarrh is purulent.) On this account he urged operation in cases where there was much effusion. Trousseau certainly did much to forward the successful treatment of simple effusions, but I doubt if it can be said that he improved upon former methods of treating empyemata for which he also employed the trocar; He recognised that in children the cases were more likely to be successful than in adults, and he relates as a fortunate example the case of Edme Bélize,[68] who was tapped three times between the end of January and August 15th 1853, and on the last occasion a "horribly foetid pus mixed with gas" was evacuated. A cannula having a metallic stopper, which could be removed at will was then left in, and iodine solution injected each day. This treatment was continued for six months when a bronchial fistula formed, and chlorine water, & eventually aromatic 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 Trousseau the circumstances which have chiefly contributed to modify and improve the treatment of thoracic effusions have been the introduction of the aspirator, (of which Drs. Protheroe Smith and Dieulafoy claim to be the inventors (69)) and of the antiseptic system of surgery. The former instrument — in some of its improved forms has almost entirely superceded all previous methods of treating serous effusions; whereas the latter system has been responsible for most of the changes which have taken place regarding the treatment of empyemata 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 asepsis 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 no doubt reduced the mortality from this disease, shortened its course and rendered sequent ill health far less common than formerly.

Clinical Features.

Empyema, 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 detailing the clinical features of this disease, it will be necessary to refer to pleuritis and to the physical signs which are common to simple 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, (Septic, Semple &c) 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 constitutes in fact the "primary" suppurative pleurities, but the degree of acuteness varies, and considerable latitude

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, feeble pulse, ashen countenance and subnormal temperature. In one such case 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 my observation, in one instance being plainly palpable as well as audible. Whether consecutive to pneumonia or beginning as a pleurisy the term acute—so 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, both

in the pneumonic and in the pleuretic cases, on making an exploration with a carefully purified hypodermic needle, very early in the disease - on one occasion before the pleuritic pulse 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 serosity. 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 ingestion of some unfresh mackerel. (4) In one case the coincidence 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 fibrous deposit, and the kidney in consequence was dilated and firmly adherent to the bowel; This latter was constricted 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 effusions). The right side of the heart too becomes overfilled, and its pulsations may be visible in the epigastrium. 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 functions of the diaphragm due to its rapid compression (vid results of experiments page 52). In these more acute cases of empyema the breathing is shallow, and it is worthy of note that expiration 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

harassing 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 axillary region than anteriorly and posteriorly. The auscultatory signs are the ones which I have found in practice to give rise to most confusion. Where the liquid has been poured out so rapidly as to compress the lung actively, the breath sounds are generally indistinct but tubular in type; when the outpouring has been less active, or after a few days, when the diaphragm has become more used to the pressure, and has perhaps in part resumed 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 known to give rise to mistakes or to doubt in the diagnosis. Egophony is almost always present in the type of the disease now under consideration.

Case I. Thomas C. aet 5 years came under observation on February 25th 1886. Suffering from post-scarlatinal 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 ascites. The throat was natural, but the glands of the neck were

slightly enlarged on both sides. The heart area and sounds were normal, pulse 144. The percussion notes were normal over both sides of the chest. The Breath sounds vesicular and accompanied by some rhonchus throughout. Temperature 101°. The urine tested on the following day was "smoky", there was a "beef tea" deposit, and a cloud of albumen was precipitated on boiling. Urea 2·1%.

On 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 104·4°. He was groaning with expiration. Pleuritic friction was audible at the lower part of the left axillary region.

Midnight:- He looked pinched and as though in great pain, moaning with expiration. Respiration 60. Pulse 163. Temp. 102·8°. The left side of the chest was moved very little. There was now loud pleuritic creaking all over the left base anteriorly, posteriorly and in the axilla; It could be distinctly felt over the precordium. The heart-sounds were distant. His tongue was furred and he was very thirsty.

February 28th 2 am. 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. 102° pain lessened. The urine passed in 24 hours measured only 50 cc, it was bloody, contained a deposit of lithates. Albumen a cloud on boiling. Urea 1·8%. The percussion note was now dull on the left side, anteriorly up to the 2nd interspace, posteriorly to the spine of the scapula (i.e twenty four hours since the pleurisy began) The heart-

was beating in the epigastrium and to the right of the sternum. Respirations 60. Pulse 160. The exploring syringe was again introduced, and this time it became filled with turbid, lymph flaked 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 trocar 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 purulent and after 5½ ozs had escaped the instrument became blocked and had to be withdrawn; 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. Respirations 48. Pulse 132. Temp. 102°—102·4°. He had passed 200 cc of urine which was bloody (red) Sp. Gr 1010. and contained a cloud of albumen. The oedema of the feet and legs was lessened but there was much of the scrotum.

March 3rd The left chest is now completely dull both anteriorly and posteriorly. Breath sounds almost entirely absent. Very faint bronchial breathing posteriorly.
The chest was now freely opened below the scapular angle and ten ounces of thin purulent fluid came away, more escaping into the dressings during the ensuing forty eight hours. 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 moist crepitation audible over the front of the chest and the breath sounds were harsh.

March 4th. 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:- plurichus and râles throughout. Temp: 98·4° Urine 600 cc. Smoky. Sp. Gr. 1013. Contains a cloud of albumen.

So far as the empyema 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 6th and the sinus was entirely healed ten days later. The boy became rapidly fat and well and on April 23rd the percussion note was resonant throughout, the breath sounds somewhat weak but vesicular and there were no adventitious sounds. The oedema had entirely disappeared by March 9th 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 on May 1st and again in June on each of which occasions the urine was perfectly normal. The heart sounds normal. The percussion note resonant throughout. Breath sounds vesicular. No adventitious sounds.

Case II. Harriett W. aet 3 years came under my notice on November 24th. 1887. 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 pained, the alae nasi 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 rhonchus scattered throughout both sides of the chest. The heart and abdomen were normal.

Owing to an accidental circumstance, (being under the impression that she had gone into a hospital) I did not see the child again until November 28th. She was then in a condition of extreme distress, pale and pinched looking, the lips cyanosed & the pupils dilated. Pulse intermitting, about 180. Respirations 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 axillary regions and at the base posteriorly, but it was drumming (Skodaic) in the upper area anteriorly. The breath sound were intensely tubular, but distant, in the impaired areas, and one could also hear numerous crepitations. The Right-side was resonant throughout, the breath sounds puerile in character and crepitations were everywhere audible. The cardiac impulse

was diffuse and tumultuous, distinctly felt in the epigastrium. Over the base of the heart was a to-and-fro rub, synchronous with the heart beats. The extremities were cold, temperature subnormal (97°6 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 ozs of thin purulent fluid; both 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 on

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 cupola 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 encroach 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 inspiration, seemed rather to interfere with it. Vid page 93. § XVI. page 96 §§ X. XI. p. 97. § XIII. p. 98. § XVII. p 100. § VI.

The diaphragmatic cupola 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 in 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 ammnt of fluid injected, but the respiratory movements themselves were shallow. This is graphically shown in the pneumograph tracing. Vid p. 95 § V. p. 96 § IX. p 97 § XIII. p 100. § VI

(2) The diminished breath sounds are naturally the result, not only of the diminished conduction through the fluid, but also of the lessened 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. § XIII. p. 97. it was found that the breath sounds became more & more enfeebled as the diaphragm descended. The enfeebled 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 healthy side the breath sounds became much louder, and harsher during and after the insertion of the fluid. p. 95 § VI.

Other experimental points - dealing with the effects upon the viscera, &c. &c. 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 pneumonic 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 hepatization of its fellow, masks 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 gets better and his friends consider him better than when the acute pneumonic 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 four (and in some cases many more) weeks ago", followed by temporary improvement, then wasting more or less rapid and sometimes diarrhoea, 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 empyema. In three cases, where wasting as had existed for from ten to fourteen weeks (in one case much longer) there was external pointing of the pus, (empyema of necessity) in one of them there being two rounded swellings, situated between the 2nd and 4th ribs and between the 5th and 6th close to the sternal margins; 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, waste very much more rapidly than others and speedily become 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 existed for even two weeks. The skin becomes relaxed and dry and often harsh when felt with the hand. There is pallor, and sometimes it is noted as being of "earthy" tint. If several weeks have elapsed the digital extremities become clubbed.

The patients complaints as regards the respiratory system are generally prominent in the history of the case. There is breathlessness, 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 suffocative attacks. As in the former class of cases expiration is often difficult, a phenomenon which is possibly ascribable to the inability of the diaphragm to relax on the diseased side owing to the superincumbent pressure (p 97. § xiii) and another circumstance connected with the diaphragm is the attitude adopted by the patient, who almost invariably prefers to be propped up or semi recumbent, 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, purulent and otherwise, especially where they have collected insidiously as in latent pleurisy, this dyspnoea 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 round the playground, an exercise which was employed each morning during the past severe weather. The master, noticing that he was obliged to fall out each day in a breathless condition, reported the matter she was brought to see me, when his left chest was found to contain 23oz of serous fluid.

Where there is much dyspnoea, 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 one breath. The voice, in thoracic effusions, sometimes assumes a peculiar huskiness.

It occasionally happens that the dyspnoea 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 dimness 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 end having been sudden. 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 interspaces were flattened out.

I have already incidentally referred to the inability of the patient to lie on the sound side, which symptom (or 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 Andral, 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 greater freedom to the movements of the healthy side, rather than from the pressure 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, in fact 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 pneumothorax 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 & many other diseases incapacitating one lung (if it be of

an acute or subacute nature) this preference for lying on the diseased side becomes manifested. This symptom is subject-like most of those already recounted to many variations, and in some cases, where the patients have become accustomed to the presence of the fluid, they have been able to lie on either side, or have even preferred to lie on the sound one, a circumstance which has in past days given rise to serious mistakes both in diagnosis and treatment. Watson records two cases where the sound side was opened in error with fatal results.

On 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 exposed in any case of even a few days duration, there will be noticed some dilitation 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 test-by mensuration would be a more uncertain 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, whose 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. ie the whole side looks larger. In older people the lower part of the chest frequently looks bulged out rather disproportionately to the upper area. In all the interspaces

are wider than on the opposite side. Unfortunately in the notes of my 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 points to note in this connection are the more horizontal position of the lower ribs (e.g. from the 6th downwards) and the widening of the angle formed by the costal margin with the linea alba owing to the elevation of the affected side of the thorax.

The intercostal spaces although generally widened out are not of necessity level with the ribs, and their bulging is still rarer. There is occasionally some inspiratory retrocession of the spaces even in considerable effusions. In all the notes of cases in which bulging interspaces were recorded, the effusion proved to be purulent.

Associated with the enlargement of the thorax, is the diminution or absence of the respiratory movements, rendered more apparent by the increased action of the healthy lung. In some cases this immobility is noted as having been "absolute" in others the expansion was "deficient" or "poor" on the affected side, the degree of immobility varying greatly.

Oedema of the affected side is generally quoted as a sign

of purulent effusions. I can only recollect having observed it twice; one case being that of a man in whom there was a serous 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 side, the skin of which became indented by every crease in the bed linen, - but also of the face and eye of the same side. In past times this oedema was much depended upon as a confirmatory sign; it however is not an early manifestation of empyema and its comparative rarity 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 Fagge, is to take up a fold of skin between the finger and thumb, and compare this with a similar fold on the healthy side of the chest.

Another occasional evidence of pus is a unilateral cutaneous blush, and the presence of an external fluctuating swelling in conjunction with other signs is proof positive. 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 useless. It is only occasionally in the emaciated, or where the chest walls are thin that they are observable and more often in children than in adults.

Diminution or loss of vocal fremitus is one of the cardinal signs of thoracic effusions, and is due to

the ill conduction of the vocal vibrations through a layer of liquid. In testing the vocal fremitus it is important to compare limited areas on corresponding points of both sides and to recollect that absence of fremitus is not essential, mere diminution being sufficient to warrant the assumption, with other indications, that liquid is present. Sometimes the fremitus is conducted at some points & absent at others, it may be on the same level, this being due to the presence of adhesions retaining the visceral pleura in apposition with the parietal.

It will be convenient here to speak of the visceral displacements of which the most important is the deviation of the heart towards the healthy side. This is a physical sign of the greatest importance, 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 interspace.

In right-sided effusions the cardiac impulse becomes transferred 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 indistinctly palpable the stethescope is the best means for locating them. In cases of simple pleural effusions which undergo absorption, the heart gradually resumes its normal situation 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 healthy side by the elastic retraction of the sound lung. This theory was introduced by Dr Douglas Powell (page 150) in 1876 as the result of experiments made on the dead body, by which he demonstrated that on puncturing the chest, the thoracic wall expanded by virtue of its own resilience, being relieved from the traction of the lung; and subsequently he 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 disputing 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 result of pressure by the collected liquid. In the first place because on freely opening an empyema the pus is often forcibly ejected, indicating great pressure, and also from what I have observed in a case of double empyema. On the 19th of last July a patient (Wm Minard) was admitted under my care at the Stanley Hospital suffering from double pneumonia which terminated by crisis on the 9th day. Three days

later the temperature which had risen each evening since the crisis, and had never quite come down to the normal line (99°) rose to 101° and on making an examination on the following day the dulness was found to have increased at the left base and there was absence of vocal fremitus. The heart beat was substernal and there was pulsation in the epigastrium. Twenty four hours later my colleague Mr Newbolt incised the chest and 27ozs 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 dyspnoea 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 5th) eleven ounces being withdrawn; but two days later, there being great dyspnoea, and evidences of increasing effusion at the right base, I asked Mr Newbolt to incise 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 recurred, and now, with the right side freely open, when there could be no question of traction by the right lung the heart became pushed over well to the right of the sternum by the accumulating pus. The old sinus 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 relaxation of the diaphragm to be the result of an inflammatory action causing its paralysis, but it has to be borne in mind that the intra-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 rarely that the liver or spleen become greatly depressed, one or two fingers breadths 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. Townsend records a case where it extended down to the iliac fossa and the patient was thought to be suffering from an enlarged liver until paracentesis of the thorax restored it to its normal position (Cyclop: of Med: Article Empyema). 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 empyema is the commoner, one would a priori expect the splenic displacement to be more frequent than the hepatic; as a matter of fact however, I can find few records of the former either in my case or other published collections of cases, whereas the latter is rather commonly noted as having been present.

The results of experiments which were made with the object of throwing light on the visceral 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 & nine) ounces of fluid have been effused (page 97. § II) and the same was indicated by taking 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 (page 97. § XIV) the impulse travelled to the left when 25 cc had been inserted.

(2) There is no pendulum like movement of the cardiac apex. The axis of the heart remained unchanged 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 exposing 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 was 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 motion to the right (the injection being into the left pleura). This was demonstrated by the movement of the style inserted into the apex, (p. 89. § II.) and the position of the latter behind the xiphisternum both 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 tracing (p. 92.) but was also aided by the descent of the diaphragm on the diseased side. The pulsating epigastrium so often noted in left-pleural effusions would be accounted for by this lowering of the apex as well as by the distension of the right ventricle which was observed in experiment No. IV p. 101 § VIII

(4) The displacement of the heart is not caused by retraction of the lung. The lung on the healthy side becomes distended. In experiment I. after the injection had been completed, the intercostal muscles were carefully dissected away; the pleura and subjacent lung then bulged through the interspaces, 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 § VIII.

(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 incising the pleura (p. 90 § VI. p. 94.) and it was confirmed in the dog, by

retaining the lungs in the inspiratory condition by clamping the trachea before opening the chest. The inter 2/3rds of the body of the right ventricle remained covered by lung. The apex was also covered by a projection forwards of the inner pulmonary border. (vid page. 101 § VIII) During contraction of the heart this thin margin of lung was projected forwards, so that the impulse felt 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 under surface of the diaphragm. In any copious 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. 97. § XIV

It will be noted that near the margin of attachment there is a concavity. 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 experimented

upon both in the dog and in the human cadaver, and in these cases the spleen lay in the concavity and was therefore not depressed by the effusion.
The liver on the other hand becomes influenced by the diaphragmatic bulging and its depression is therefore commoner.

The percussion note in Emphysema 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. Its quality gives no indication as to the amount of the outpouring, but its level as noted from day to day (in these less acute effusions affords 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 endeavoured to ascertain whether by altering the patients 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 greater 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 decubitus adopted by the patient, which allows the fluid slowly to collect at the most dependent part. It must be remembered that the Skodaic resonance continues from the 3rd rib upward in cases of copious effusion and that its limitation

by the 2nd 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 auscultatory 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 heretofore; for although the breath sounds are often noted as 'absent'; they have more frequently been "weak" or "feebly conducted" and when this has been the case they have very generally been Tubular in type. This absence or enfeblement of the breath sounds is a characteristic which although the most common - and always a valuable positive 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 loudly conducted, it may be over a considerable area where there is dulness on percussion and loss of fremitus. It is difficult to account for this conduction of bronchial 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 aspirator. 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 – on 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 its use should not be omitted where there is any doubt, but it must be remembered that failure to withdraw pus or serum 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 lotion which coagulates the effused liquid and so prevents its passage into the cylinder 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 stronger 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, for over these when they are of any extent, either insular or linear, the respiratory sounds are almost invariably tubular and well conducted. The case which I append here illustrates this and shows how the diagnosis was further masked 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 misfortune that an adhesive point was punctured each time.

Case :- Charles R. aet 11/2 was admitted into the childrens Hospital at Pendlebury on October 10th 1885. with a history of having lost flesh for about six months. He 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, anemic looking; The finger ends clubbed and there was much downy hair on the back and limbs. The chest was sunken below the clavicles on both sides. The movements of the right side were deficient, The resonance impaired all over, and the breath sounds weak. The percussion note was especially dull over the upper third of this side, and the breath sound bronchial in character. On the left side there was impaired resonance and bronchial breathing down to the third rib. No adventitious sounds. The temperature was hectic in character.
On October 19th The right-base was explored, and an ounce of clear serum withdrawn; On the following day 3/2 ozs of serum were abstracted through a southeys trocar, but bright-blood appearing the instrument was withdrawn. After this there was improved resonance of the right-side and the general health became steadily better until November 25th when he was able to get-up. On December 2nd. the temperature which had previously been normal, began to rise, and from this date until December 21st presented evening exacerbations. On December 10th it was noted that there was some slight-dulness at the right-base and the breath sounds

were diminished. On exploration with a needle, nothing was withdrawn. On December 21st the dulness on percussion extended to the 5th rib; but on again exploring posteriorly some blood was withdrawn. There 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 13th 1886 there was no change for the better. The breath sounds were bronchial and fairly conducted. It was now believed that the case was one of chronic pneumonia of tubercular 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 resonant or hyper-resonant note on percussion, the breath sounds seemed to be amphoric in character, (no pus had been expectorated), and while actually listening, these breath sounds suddenly, and entirely disappeared, and the percussion note simultaneously became dull. There could be only one explanation for this viz:- that an adhesion had given way - allowing fluid to extend - so again the needle was introduced, and this time it filled with stinking pus. Next day (Jan 22nd) thoracentesis 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 manifested by the tinging of the sputa with the Condys fluid used 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 sinus to be reopened on May 22nd. On June 24th the tube 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 sound vesicular but weaker than on the opposite side. He was re-admitted on July 24th, the sinus having opened again, and there was found to be a small pouch, about 2½ inches deep, which being drained – the sinus 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 tubercular 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 murmur audible in the interscapular region 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 opposite lung, usually puerile in character may be very distinctly heard over the diseased side, and may be known to be thus conducted by their intensity increasing when traced towards the healthy lung.

Ægophony is present or absent – according to the amount of the effusion. It is a variety of bronchophony, modified by transmission through a thinnish layer of fluid. There only remains to be mentioned a variety of ægophony, described by S Bacelli of Rome and known as the "pectoriloquie aphonique"

which he regarded as a means of distinction between serous & purulent-collections. In the former when the patient-repeated 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 to the ear directly applied, or through the stethescope) 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 pus, and absent when there was none.

Chronic Empyema.

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 fistula, or by operation, there is generally contraction of the side. Many cases result 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 & carnified, 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 extent 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 empyema is a sequel or complication, and upon the condition of the lung as to its expansibility.

Case:- Gertrude H. Aet 6 years was admitted to the Hospital at Pendlebury on November 8th 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 ozs of pus were removed by means of a trocar.

On admission:- She was anaemic and emaciated:- Expectoration abundant; mucopurulent in character. The left chest was dull on percussion - there being a great sense of resistance. Vocal Fremitus absent. Breath sound weak bronchial. There was a marked dorso-lumbar spinal curve, the concavity being to the left. The cardiac impulse 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 sweet pus escaped. Two tubes were inserted, and antiseptics were employed, but on November 25th the discharge was offensive the chest was washed out with weak condys fluid. On November 28th there began to appear traces of albumen in the urine.

December 1st Masses of lymph came away on removing the tube January 9th 1886. Temperature markedly hectic; discharge not offensive and draining quite freely from the tube, but it seems to collect in pockets 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 parts of the 7th & 8th ribs 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. No post mortem examination was granted.

The following is an abstract of a case quoted by Dr Wardell (Contributions to Path: and Pract: of Med: 1888 page 298). A clergyman in Cornwall aet 36 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 dyspnoea, and became emaciated. He then consulted a physician who discovered that the left chest was round and smooth and the cardiac impulse to the right of the sternum. Paracentesis was performed and eighteen ounces of very foetid 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, & was then much emaciated; his side contracted so that he leaned towards the affected side when walking. There was difficulty of breathing. Pulse 100. The stench from the sinus was very offensive. The respiratory murmur was in no part audible except at the interscapular space where distant breathing was heard. He remained in this condition for another year (six years and four months since the advent of his illness) and was then admitted into St Bartholomews Hospital. The sinus was now explored with a large gum catheter, which, after passing through a tortuous channel for nine inches, entered a cavity from

whence forty four ounces of dark, dirty, decomposed pus, which gave off a most offensive sulphuretted 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 or five ounces a day) and his general health became considerably improved. His chest was syringed out each morning with warm water and after this had been repeated daily for about two months the amount of discharge was only about one or two ounces a day. He was given a liberal diet, with wine, porter quinine, bitter infusions &c 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 erect, the left thorax almost expanded to its normal. The respiratory murmur could be traced down to the 9th 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 & a half years before the final notes of his case were taken.

The Diagnosis of Pus from Serum:— may be conjectured from the nature of the initial disease, whether septic or infective; From the occurrence and repetition of rigors and from the presence and persistence of hectic with sweating during sleep and rapid wasting. These, existing either from the beginning of the illness or supervening in a case where there has previously been effusion of serum

The pupils are frequently dilated where there is pus, and its presence would be indicated also if there were bulging interspaces, external pointing or oedema of the side. As before remarked Bacelli's pectoriloquie aphonique is not reliable The best means of distinguishing the nature of the effusion is 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 plugging of the instrument. In some cases the general adynamic character of the illness is indicative of pus, the disease assuming a typhoid 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 foetid. The matter varies in colour from green to yellowish, or it may have a dirty reddish tinge from the admixture of blood. The physical signs in the chest are usually immediately altered owing to the entrance of air; the signs of pneumothorax supervening; but this is not essential, and to explain the absence of pneumothorax in these cases, the older physicians were accustomed to state that the pus was absorbed by the pleura and again 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 extremely foetid. I believe this to result from the presence of a small slough not yet-

separated from the spot where the fistula 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 thoracentesis, both in cases where the pus has been sweet 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 loculated variety of the disease. In two cases which I have seen post-mortem, they have been linear, extending from above 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 too the pericardium was filled with purulent fluid. Of cases observed clinically, the one recorded at page 72 (C.R.) must have had several insular adhesions since the pus was all evacuated by a single incision. In another case. (Gregson. page 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 localised empyema situated at the apex of the left thorax, and consecutive to apical pneumonia.

Case:— Ada Seddon aet 28. was admitted into the Stanley Hospital on Feb 12th 1894. Six weeks previously she had been seized with a rigor 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 pyrexia and since that time has suffered from cough, breathlessness, emaciation and increasing debility.
On admission she was sallow looking, expression anxious. She lay constantly on her left side. The breathing was rapid and shallow. The right chest was resonant, hyperresonant. Breath sounds harsh vesicular; no adventitious sounds.
On the left side there was dulness on percussion, extending from the apex to the 3rd rib in front and to a point midway between the spine and the angle of the scapula posteriorly. Here there were faintly audible breath sounds and the vocal fremitus and resonance were much impaired. The temperature was hectic in character. The voice was husky. No displacement of the heart was noted. About five days after admission, she suddenly coughed up a large quantity of greenish yellow pus; it came in such amount that she was in great danger of being suffocated and had to be inverted over the side of the bed to prevent this accident. The physical signs at the left apex were immediately altered after the escape of the pus; the percussion note became hyper-resonant, the breath sound loud and blowing and there were loud, coarse crepitations. The breath sounds later on became harsh vesicular in character but the crepitations persisted for many weeks after she had become an outpatient. Eventually she became perfectly well in health but when last seen (July 1894) there was some impairment of the percussion note over the left apex. The breath 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 rheumatism is seldom followed by purulent effusion.

Cardiaceous Disease:- May result from chronic emphysema as from any other chronic suppurative condition

Diagnosis

Phthisis:- The hectic, wasting and dyspnoea together with the sigularity of the physical 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.

Aneurism:- Walsh directed particular attention to the pulsating emphysema and its liability to be mistaken for aneurism. Sometimes the pulsation has been in an external swelling (pulsating emphysema of necessity) in others it has been limited to the intercostal spaces. No case of either description has presented itself in my own practice, but the diagnosis would depend upon the situation of the pulsation, the absence of thrill and of bruit, and upon the presence of the other signs of emphysema.

Costal Abscess:- requires to be mentioned because occasionally a pointing emphysema has been opened in mistake for one of these. I have notes of such a case. The diagnosis obviously present no difficulties

Case:- George B. aet-10. Admitted into the Childrens Hospital, Pendlebury. January 3rd 1885. He had been ill for about two years, his ailment dating from an attack of pleurisy which

lasted for six 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. No tube was inserted, and the discharge has been free from the wound ever since.

On admission:- he was fairly nourished but pale; finger ends clubbed. There was a large sinus in the 6th right interspace, in the nipple line - passing downwards and inwards. 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 5th - 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 condy, 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 bronchophony sometimes present in the latter. The absence of fremitus 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 pathologist to the Royal Southern Hospital) making a post-mortem on a case which had been admitted as being of this nature. There was an enormous encephaloid growth of the right lung which during life had distended the chest and the breath sounds, vocal resonance and fremitus were absent. Serous effusions, however, are frequently the result of cancerous growths, and if on aspiration of a chronic effusion the fluid proves to be blood stained, it is very suggestive of malignancy.

An Enlarged Liver:— Sometimes very closely simulates a right-sided effusion. Its 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 ribs, 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. Fremitus is present over some of the dull area and the conduction of the breath sounds is louder than if the dulness resulted 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 Southern 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 angioma 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 aperture through which the pus made its way into the pleura - from the liver

Aetiology

Pneumonia:- is the commonest antecedent of empyema both in adults and in children. It is interesting that while I was resident in Childrens hospitals, the cases resulting from pneumonia were all admitted for the sequent disease, whereas of fifty six cases of croupous pneumonia, tabulated by myself, as having been under treatment in the General Hospital for Children at Manchester, during the year 1885, 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 1881—85 there were 235 cases of croupous pneumonia treated in the hospital, and of these only one became empyaemic, (Vid Pendlebury abstracts 1881-1885) an experience which would seem to indicate that post-pneumonic empyema must result most commonly from some error in the management of the convalescent period.

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

Pleurisy:- is sometimes purulent from the first, or the effusion after remaining serous for some time becomes purulent. It has been stated by some (Watson, Stokes &c) that paracentesis 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 lessened 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

notes of one case of empyema which occurred in a girl suffering from acute Bright's Disease, without any ascertainable history of scarlatina. It succeeded an intercurrent attack of pneumonia.

Tubercular 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 Chauffard and Gombault have produced tuberculosis in guinea pigs by subcutaneous injections of the sero fibrinous fluid from pleurisy in phthisical subjects. (Page 180 ✻✻) It has been observed by some that empyema is never followed by phthisis, 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 tubercular pleurisy is common, and that it has little tendency to suppurate, whereas the commonest causes of empyema are non tubercular.

It was long ago observed that the occurrence of Empyema or of ~~pyo~~pneumothorax in phthisical 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 tubercular foci (vid Stokes - Diseases of the chest.)

Disease of the Vertebral Column and Necrosis of the Ribs and Sternum 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 suppurative inflammation.

Foreign Bodies:— such as bullets &c. are recorded as causal agents, 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 inconvenience from its retention.

Prognosis

The prognosis in empyæma depends largely upon the cause of the disease. Scarlatinal and septicæmic cases very often recover but in most of those having a septic 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 fistulæ and of contracted thoraces. The occurrence of a bronchial fistula adds gravity to the case, immediately, because the pus may become inspired into the lungs and give rise to septic bronchio-pneumonia, and remotely on account of the permanent deformity and impaired health which is apt to ensue unless immediately treated by operation.

Suffocation has occurred from the sudden discharge of an empyæma into the bronchus. I witnessed an approach to this accident in a patient whose empyæma burst while I was in the ward (vid page 81). and I believe she would have been placed in great jeopardy had I not inverted her over the side of the bed.

The prognosis in an untreated case is bad, both as regards

the immediate prospects of life or the ultimate perfect restoration to health. In some few cases the pus has been known to undergo absorption.
The prognosis in chronic empyema is also unsatisfactory

Experiments made in connection with the Effects of Thoracic Effusions

Experiment No I:- On the body of a girl aet 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 dullness 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 5th interspace, into the cardiac apex; its direction being vertical. About 90 ozs of water were then gradually injected into the left pleural cavity, the results being carefully watched.

II

While the first 9 ozs 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, upwards 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 axilla. At this time the tension became so great that the needle parted company with the heart.

III

When the cardiac stigle began to travel upwards, it was noticed that the abdomen was rather more distended than before the experiment was commenced, and a second needle was then inserted into the left lobe of the liver just between the xiphisternum 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 linea alba was widened. On percussion the ascertainable cardiac dulness extended 2 1/16 inches to the right of the mid sternal line, the absolute dulness being just internal to the right nipple line.

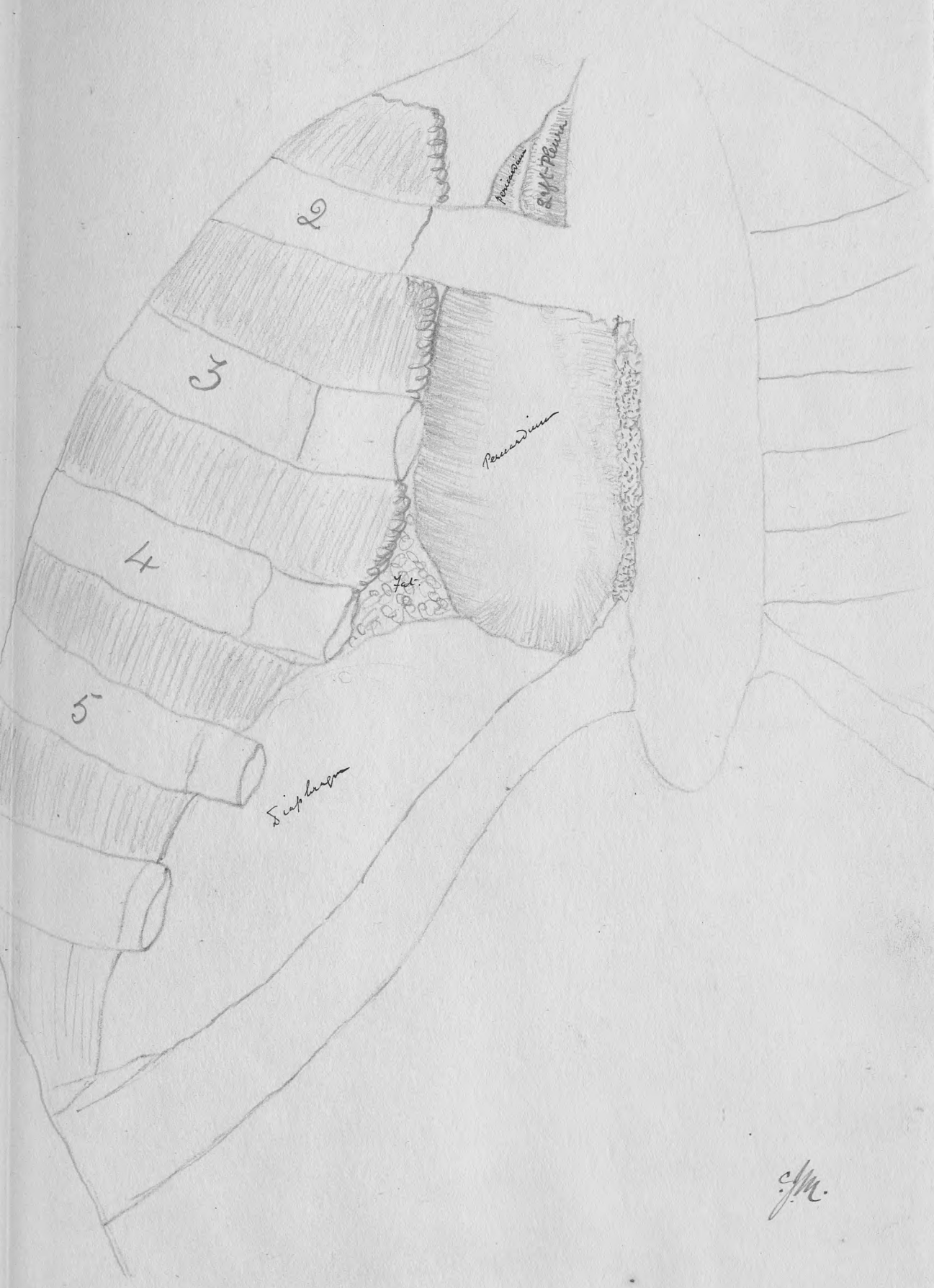
V

The muscular structures (which were bulging) were now dissected 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.

Tracing No I.



C.M.

VII

The distended left-pleura, peeped from behind the sternum for 1/4 inch in the 2nd interspace, and gradually sloped away downwards and to the left-behind the third rib.

VIII

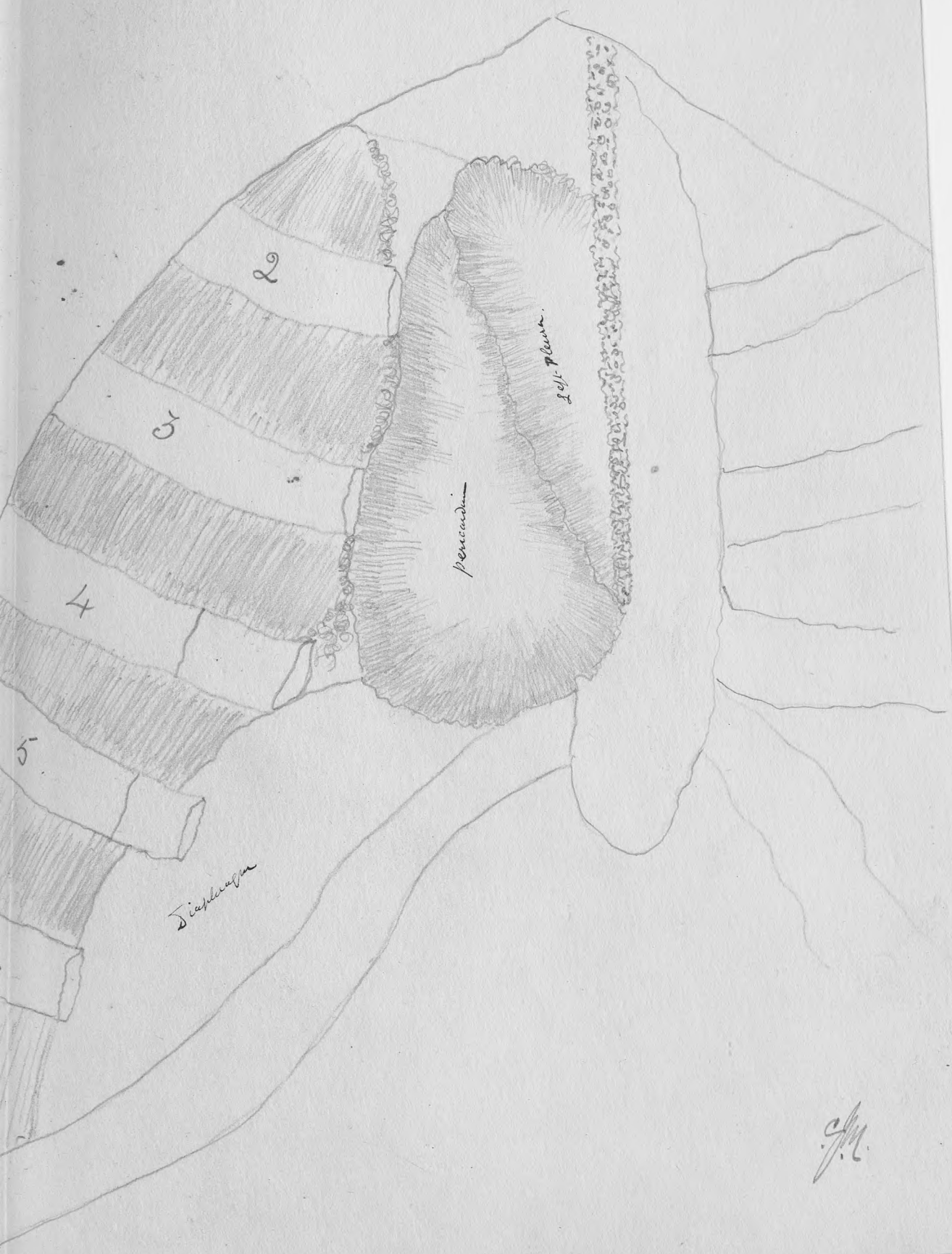
A mesial longitudinal section was now made of the sternum from the 2nd costal cartilage down to the seventh, and the right-half, together with the cartilages of the 3rd, 4th, 5th and 6th ribs, was removed, leaving the 2nd costal cartilage and the 7th. The pleural membrane was then incised and the lung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

IX

The pericardium was now exposed, & so much as was visible extended 1/4 ins from the mid sternal line in the first interspace; 2 ins inches in the 2nd & 3rd. The diaphragm was arched upwards & extended to the lower border of the 4th costal cartilage at its junction with the rib.

A tracing was now taken without further disturbing the parts. (Vid Tracing No I.) The photograph shows the displaced pericardium.

Tracing No II.



X

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.

XI

Without incising the pericardium it was observed that the anterior surface of the heart looked 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.

XII

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.

XIII

The medial section of the sternum was now completed upwards 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 bulbous swelling above, overlying the heart and helping to depress it. Tracing No II was now taken.

XIV

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.

XV

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 vessels (especially the pulmonary artery) might account for the basic murmur sometimes audible in left sided effusions; and the distended right ventricle would also be in part accounted for by the compression of the pulmonary artery.

XVI

To investigate the under surface of the diaphragm the abdomen was now incised (the stomach was found later to be enormously distended) an aperture being made large enough to admit the finger, which was pushed through the peritoneum. The diaphragm on the left side was found to be convex downwards; on the right side (as previously observed from above) it was convex upwards. Hence the entire under surface as traced from side to side was shaped thus :— (right ~ left.) but the central portion of the left cupola was considerably more depressed than the parts adjoining its attachments to the ribs anteriorly and laterally so that on the side there was a little bay in which was lodged the upper extremity of the spleen. 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 ensiform cartilage

XVII

The spleen was entirely sub-chondral, as was also the depressed diaphragm, neither could have been palpated through the abdominal parietes.

XVIII

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 glass cannula round which the trachea was ligatured. A small incision was now made (1/2 inch long) exposing the 4th right intercostal space, half an inch from the sternal border. 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 1/2 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 fixed over the blunt end of a large probe, that it could readily be inserted into the pleural cavity when the interspace was divided.

III

A minute puncture was now made - through the intercostal structures

into the pleural cavity, and this was at once covered with the finger. The india rubber bag was then quickly inverted, and it slipped into the right pleura (without the entrance of any air) until the glass tube filled the intercostal aperture. The skin suture was then drawn tight and firmly tied round the glass tube.

IV

The chest was auscultated and percussed 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 respiratory sounds were louder and harsher than formerly.
On the right side the percussion note was much impaired and the vesicular murmur conducted very feebly, except-ing posteriorly - where it was louder and more puerile.
The heart-beat could not be felt on either side, and on the left it was masked on auscultation by the loud breath sounds.

VII

50 c.c. more water were now injected with great caution (the chest now contained 250 cc) and the tube was again clamped.
The results on auscultation and percussion were unchanged

in kind but intensified in degree

VIII

A small incision was next made in the epigastrium, through which the finger was introduced to explore the under surface of the diaphragm.

IX

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 cupola.

X

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

XI

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 resume its arched form on the right - owing to the pressure of the superincumbent fluid. i.e. the contractions were valueless (practically) so far as inspiration is concerned on the diseased side.

XII

As a control experiment - the india rubber tube was now unclamped, and 245 cc of fluid escaped - presenting respiratory waves as it did so. The lung therefore had re-expanded again. + this was further confirmed by the return of the breath sounds and

of the resonant note 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 impulse travelled somewhat to the left. - there was an appreciable movement to the left - when about 25 cc had been injected:

(2) The right cupola of the diaphragm at once began to show less arching upwards - therefore inspiration became early interfered with, 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 vigour 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 on the two sides - but the contractions of the right half were unable to be effective.

(4) Over the right side the breath sounds became progressively enfeebled 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 thin plaster of paris.

XV

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 postero-lateral parts 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.

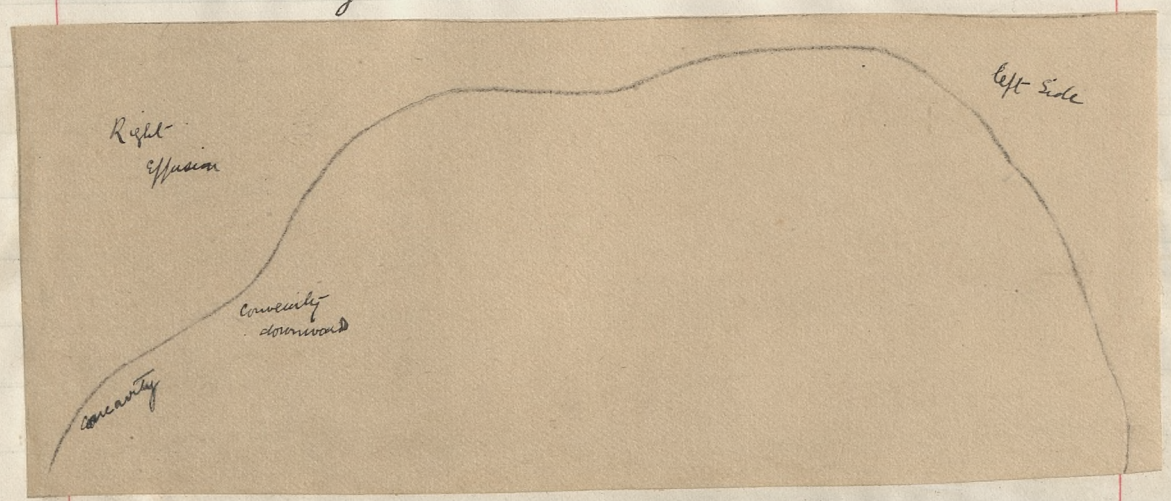
XVI

The ribs 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 apposition with the bag and its cavity evidently encroached 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.

XVII

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

Tracing taken from the plaster cast.



I

Experiment No IV A medium sized dog having been placed under the influence of ether as in the former experiment, an incision 3/4 inch long was made over the 6th left intercostal 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 suture was firmly tied round the glass tube.
The chest was examined, and the percussion note found to be resonant throughout. The Breath sound 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 effects of the infusion 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) enfeebled. 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 inserted, 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.

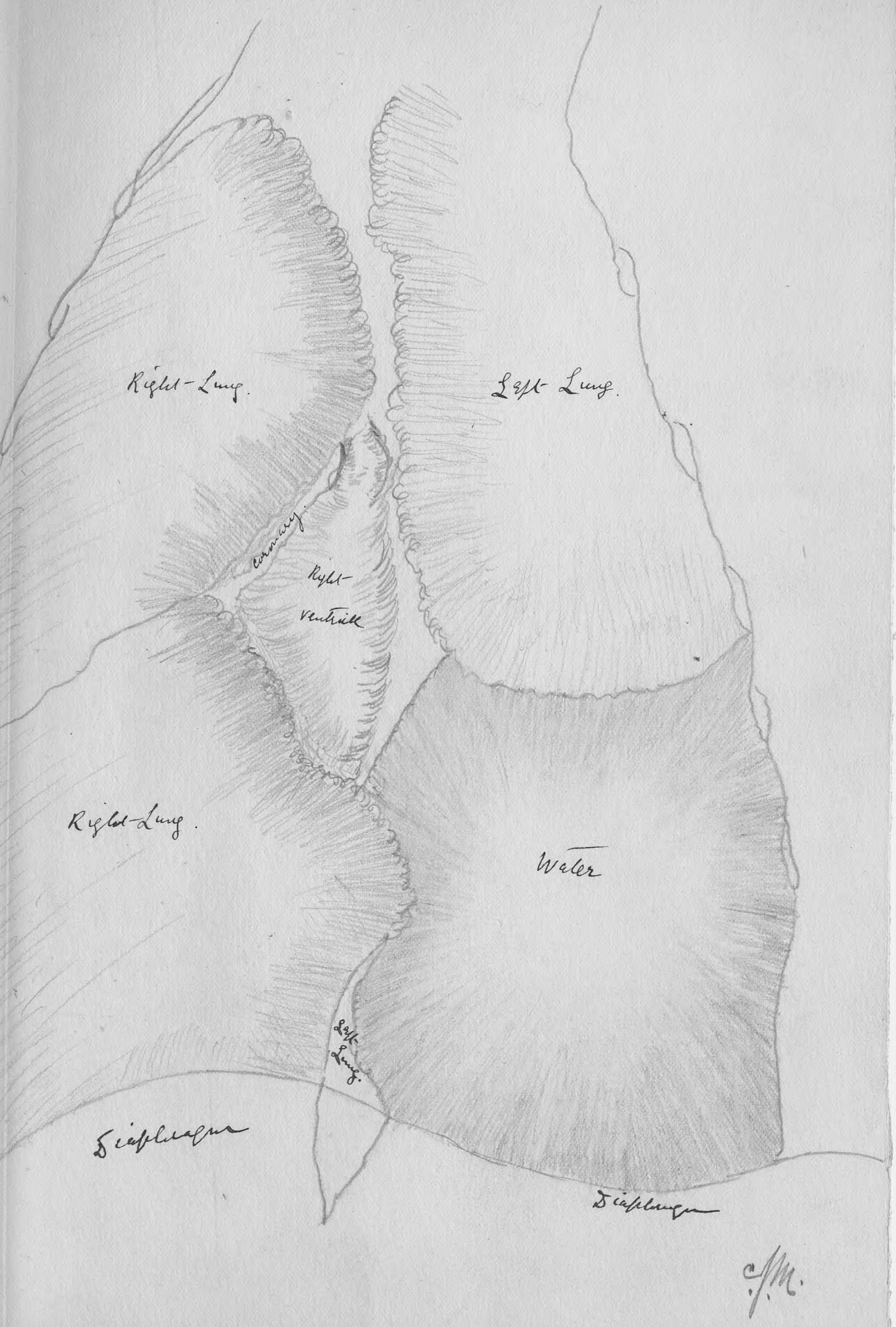
On the other hand the movements of the right-chest became more and more exaggerated the extra ordinary muscles of respiration including the diaphragm and intercostals, all acting vigorously.

V

At this time the percussion note was dull all over the left-base, but resonant, if not hyper-resonant in the upper 1/3rd of the chest. The breath sounds were almost inaudible over the dull area, but vesicular in type (The absence of any tendency to a bronchial ~~type~~ would be explained by the absence of the larynx). In the upper 1/3rd of the chest the sounds were harsh vesicular both anteriorly and posteriorly. On the Right-side the percussion note was resonant, the breath sounds harsh and vesicular throughout. The heart-could be heard beating to the right of the sternum.

VI

An incision large enough to admit the finger was now made in the epigastrium and the diaphragm explored from below. On the left side the muscle presented a central, slight convexity and there was a slight concavity near the left region of attachment as noted in former experiments. During inspiration the central convexity 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 encroachment on 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 cupola and the xiphoid cartilage, rather nearer the latter.


Right-Lung.
Left Lung.
Coronary.
Right-
Ventricle
Right-Lung.
Water
Left Lung.
Diaphragm
Diaphragm

VII

Chloroform was now substituted for the aether and was pushed until the animal had quite ceased breathing. The lungs were then inflated by blowing through the india rubber tube connected with the trachea and this was then clamped in order to retain the lungs in the position of inspiration.

VIII

The right-side of the chest was then rapidly opened by cutting through several of the ribs and cartelages with a small pair of bone forceps. A portion of the heart was thus exposed (about its inner ventricular third. 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 alteration in the cardiac axis. Its long axis was from above downwards and inwards.

The apex was situated near to the ensiform 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 perspiration).

IX

The great vessels at the base were all displaced to the right side

X

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 2/3rds 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 &c - over the upper part of the chest. The lower posterior portion of this lobe - was partially collapsed.

XI

Having placed the parietes 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 pendulum like motion 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 coexisting as well as antecedent diseases which are essentially in the physicians province, and its recognition, as well as the complications which are apt 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 effusion which are known to be primarily serous, and at length tend to become purulent, empyema may not be prevented. Of this I feel sure, that besides the prophylaxis which consists in the careful nursing of pneumonia and some of the other diseases apt to give rise to purulent effusions if neglected, there are a certain number of serous cases which can be prevented from becoming purulent by a timely withdrawal of the liquid. I have suspected this in two or three occasions, particularly in children (who are so prone to empyema) recovering from pneumonia, who have had consecutive signs of effusion, and in whom, on exploration, a turbid liquid has manifested itself, & this being subsequently withdrawn has proved to be small in amount, and has not re-collected. I am disposed to think that there were cases which would have become empyemata had the liquid been allowed to go on accumulating. This impression, together with the fact that there are certain primary pleurisies having a tendency to

become suppurative if their effusions are allowed to remain too long, again reminds one of the impossibility of separating practically the serous from the purulent cases, and all the transition varieties known to exist between the one and the other; and since the latter may be regarded as very early empyemata (when the fluid is sero-purulent) it will be necessary for me to speak of the methods of treating them as well as of those employed in cases entirely purulent. I am well aware that it is by many thought dangerous to tap a simple inflammatory effusion; not only on account of the risk of introducing some septic 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, is apt to be followed by a similar result, quite apart from the question of septicity. Of the former accident there can be no doubt, and the means for preventing it are sufficiently obvious; but of the latter I am very sceptical, 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, if one may judge by the diminished fever, and improved digestive functions which so often ensue, together with the pertinent circumstance that the exudation, which is the resultant of the inflammation absent never re-collects, or if only partially removed the absorption of the remainder is often brought about. (It must not be understood that I advocate paracentesis immediately the effusion has become evident in a case of pleurisy. My 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 exudation which is increasing or which shows no tendency to become reabsorbed is hurtful 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 becomes organized and prevents its subsequent perfect expansion, or by becoming converted into an empyema. These are considerations which have led me not to press therapeutic measures to the exclusion of operative ones even in cases of moderate inflammatory effusions where increase is going on, highly as I regard them as valuable adjuncts. It is admitted that absorption can be brought about in many instances even of copious effusion by purely therapeutic means, but in view of the fact that relief is so speedily attained by puncture, and that its careful performance will, instead of involving danger, be likely to promote convalescence and prevent ultimate risks, there need in my opinion be little hesitation in removing the fluid often only a few days. In brief then my recommendation is that if an inflammatory effusion is per se causing symptoms of distress, it is better to remove it than to wait until it attains to any particular level, and on no account should it be allowed to remain at all, if on exploration it has the appearance of undergoing a purulent 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 child, who after an attack of Hooping Cough remained in a weakly condition for some time, and at length got an attack of pneumonia implicating 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-base posteriorly, absence of crepitus, but well marked egophony and dulness on percussion. With the aspirator six ounces of very turbid fluid were withdrawn, and after this the physical signs and fever quickly cleared up and recovery was established shortly afterwards. It is interesting to look back upon the experiences which one has 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 rarely treated with the aspirator during the first year or two of that period, whereas now the trocar, which was then in favour is seldom employed in serous exudations. In discussing the relative merits of these two instruments at that time, one often heard it alleged that the aspirator, by forcibly withdrawing the fluid was apt to cause so active a filling of the pulmonary vessels that a dangerous oedema was liable to ensue, 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 anxiously 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 harmlessness, was undoubtedly sometimes followed by the transformation of these serous effusions into purulent ones; and partly to avoid this accident and in part to exercise a moderate siphon like action, the cannula was generally attached to a rubber tube which dipped, at or near the floor level under a solution of Carbolic acid. The late F Martin Duncy - who in 1884 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 accomplish this he employed an ordinary short Southeys cannula, having its

long capillary rubber tube conducted into a vessel containing a measured quantity of carbolic solution. My earliest notes of pleuritic cases, taken while working with Dr Oxley and with D Hyla Greves at the above hospital, bare record of the results attained 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 coagula, that - before my period of presidency was completed Southeys cannula and tube were abandoned and an instrument of wider caliber substituted. I learnt two lessons however from the employment of Southey - one being the unsuitability of carbolic acid for being brought into contact with coagulable effusions in fine bored instruments; the other - the danger of inserting a fragile instrument over a bony ridge like the rib. The very last case in which I saw Southeys cannula used, it snapped over the rib, and the inner fragment was only extracted with the greatest difficulty. The ordinary trocar and cannula with its attached rubber siphon tube also gave very good results in these cases - one of the larger bored Dieulafoys cannules being ordinarily 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 accrues 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 cannulæ.

Of late years I have employed the aspirator exclusively for serous effusions of all kinds and I cannot remember having seen anything approaching a serious sequel to its use. The principal accidents

associated with aspiration of the chest are dependant upon the kind of instrument employed and although every credit is due to Dieulafoy for having introduced this method, I confess that I do not like his instrument. It is too apt to get out of order, the rule rather than the exception being, that if wanted 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 fittings are not airtight and that a mixture of air and serum entering the cylinder, the former is apt to find its way into the thoracic cavity if the exhaustive action is stopped. Then 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 doubtful one - as I shall presently show when speaking of the forcible injections of fluid into the thorax; and if with a faulty instrument which has admitted air, or one which may have escaped being rendered thoroughly antiseptic after a former aspiration, some infected fluid is returned into the chest, we need hardly say that the greatest advantage of the aspirator is discounted. The aspirator should never be so devised as to receive the effused 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 typpe of instrument has the additional advantage that as the bottle fills, the vacuum becomes lessened 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 Dieulafoy type exerts the same amount of pressure with each withdrawal of the piston.

The "bottle" aspirators are very serviceable and unlikely to get out of order, some of them are provided with hollow needles which require the precaution not to injure the lung with the sharp point; others (eg Potains) have an unsharpened cannula through which a trocar passes, and the construction is such that by means of a stop cock 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 becomes plugged with coagula or fibrinous flakes, a blunt stilette can be inserted to clear it.

Regarding the site for operation:- I believe the seventh interspace 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 flexes 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 on again placing the arm at the side. The puncture should never be made higher than the middle of the intercostal space and care should be taken to direct the point of the needle horizontally, in order to avoid injuring the intercostal vessels above, and 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 faintness which is so often spoken of as being one of the dangers of paracentesis, is shock caused by the perforation of the skin. This faintness 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 freezing either with ice and salt, or chloride of Ethyl or Aether; then the insertion should be made quickly, and what is of as great importance - suddenly - with one steady push penetrating all the structures 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 recognised causes of disappointment in the operation) will seldom occur. I have never witnessed either complete syncope or sudden death from paracentesis but that they have occurred both during and after the operation is undoubted. The latter has been ascribed to the separation of emboli from the displaced vessels.

It is not easy to lay down rules regarding the amount of fluid which should be withdrawn, and each case has to be treated on its own merits. I am under the impression however that a relatively larger amount may be abstracted in acute than in chronic effusions and with greater probability that the absorption of the remainder 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 untethered by thickened deposits readily expands. In general I have been guided by the patients 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 empyema during the past ten years have been in the methods of after treatment rather than in the principle of the operation. There being very few surgeons now who advocate paracentesis with the trocar

or 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 known it to be curative; this was however an exception to the usual sequel of any method of operating which does not provide prolonged and free drainage, and now, this principle being recognised, 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 Gregson already referred to as one complicated by adhesions (page xx) I have often thought that the aspirator may have been responsible for the loculation of the pus. It was employed in the first place because the secretion was thought to be serous, but proving purulent, it was withdrawn to relieve symptoms. The visceral relations were restored 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 8th interspace in the line of the scapular angle) but greatly to my disappointment only three ounces of matter escaped, and although posteriorly and below, the percussion note was rendered more resonant, it was evident from the continued 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 sixth interspace in the anterior axillary line, when about ten ounces of sweet pus were discharged and the patient, a man aet 34 made a good recovery. This case made me suspect that the adhesion took place after the aspiration, and the pus again collecting had become divided into two portions. Since this experience I have

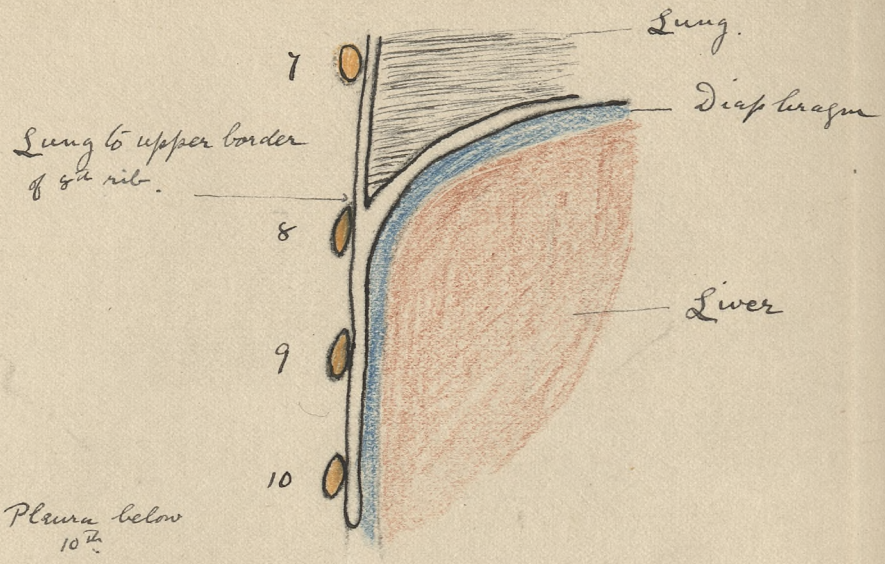
preferred not to withdraw any pus with the aspirator, in case of complicating the subsequent treatment.

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 has become equalised. 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 wash out the chest. If this is done as a routine practise, I agree that it is important to have some such means of preventing active pressure upon the pleura (See page 117) but since the cases actually requiring this treatment are few and far between, there can be little object in anticipating its necessity by having a counter opening in every case.

Although in inflammatory exudations of a serous character, there is some difference of opinion as to the wisdom of early paracentesis, 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 probability will there be of an early recovery. Sometimes it has been argued that the patient should be allowed to rest, and that his nutrition should be improved by careful dieting before operation, but when we consider that the risks to the lung are enhanced by every delay, and that the loss of nutrition and debility are but symptoms of the disease, the rational procedure is surely to remove the offending matter with 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 pointing of the pus is rare, because the tension is exerted upon movable and compressible structures, which must be greatly displaced before any localised 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 thickened as little as possible. I have seen several cases where comparatively early thoracentesis was performed (of which Gregson page, 111 and Quinard, page 63. are examples) followed by contracted sides, indicating that the expansibility of the lung may be impaired very early; and most cases of chronic empyema depend upon the lung being so bound down that the visceral and parietal pleural cannot be brought into apposition. Much 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 discovered with the exploring syringe. I have seen some few cases operated upon anteriorly, between the nipple line and the anterior axillary line; a good many have been opened laterally, and in many own cases the incision has invariably been made posteriorly, or to speak correctly - postero 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 anterior seat 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 dependent. (2) The base of the pleural cavity is convex upward, and corresponding to the arch of the diaphragm, is considerably deeper posteriorly than anteriorly and laterally. The relations of the

Espiration



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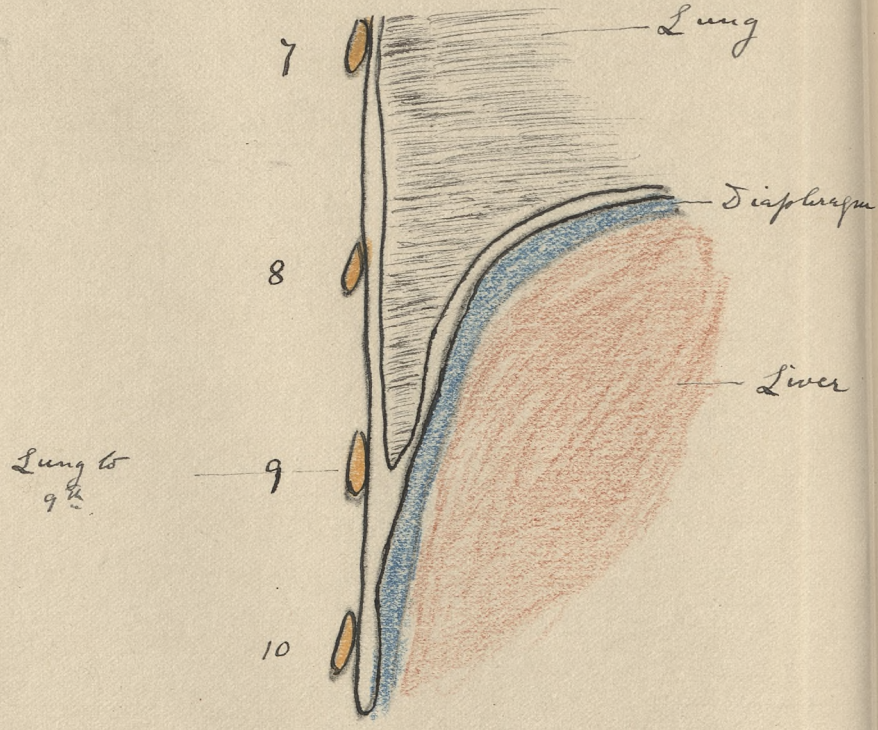


Testut

anterior pleural border being :— On the right side — after running down behind the sternum to the ensiform cartilage, it passes outwards upon the seventh costal cartilage — then across the eighth and ninth, meeting the tenth 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 downwards and outwards behind the fourth space, fifth costal cartilage, fifth space, sixth costal cartilage; along the seventh and across the eighth, ninth & tenth ribs, reaching the lower border of the latter in the axillary line; being here somewhat deeper than on the other side; It then passes along the eleventh rib to the neck and head of the twelfth ½. (3) In (page 150 ***) correspondence with the foregoing the diaphragm is higher anteriorly and laterally than posteriorly; The diagram shows the relationships of the lung to the chest-wall during inspiration and expiration.

With the patient lying on his back there will be freer drainage with a posterior incision, not only because of its greater dependancy, 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 witnessed :— 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 relations, due to the position of the patient being different before and after making the incision. This muscular difficulty has been cited as an additional reason for making an antero-lateral incision, the muscles being thinner anteriorly than posteriorly. In the posterior axillary line however, there is very little muscular covering over the seventh and eighth interspaces, and these spaces constitute the seats of election at which my own cases have been operated upon.

With this preference for a postero-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 1/4 to 1/3 inch). Generally after incising the pleura the wound has been enlarged with a probe pointed knife guided upon a director, or by Hilton's method. In my earlier hospital days it was customary to insert a very long tube - from four to six 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 now when a much shorter tube is used, the cases have neither been of longer duration nor has any 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

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 pleura it may lead to necrosis. Morrant-Bakers rubber tracheotomy tube has never proved a success in my hands; its caliber is too narrow and it tends to kink and so interfere with free drainage. The tube having been inserted, it is guarded in the usual way with a safety pin & a piece of protective is interposed between this and the skin. The usual absorbant antiseptic dressings are used and after the first day or two, they may often be left undisturbed for several days.

Excision of a portion of rib to give more room for drainage in acute empyema is a measure which does not command itself to me, for the simple reason that cases do just as well without it. I have not experienced inconvenience from the interspaces proving too 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 periosteally, and practically no deformity ensued. On the other hand the necessity for this procedure becomes apparent in chronic cases, where the sinus will not and cannot heal owing to the non-expansibility 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

saw at Pendlebury when resident there, after re-section of the pits the hopelessness of ever getting the lung expanded, or the chest wall sufficiently contracted without operation was demonstrated by the way in which the exposed pleura fell in, after the resection of the pits. Another Pendlebury case of which I show the photograph gives some idea of the amount of contraction of the side, and deformity of the spinal column or which may follow this operation.

After Treatment

In accordance with modern antiseptic methods, after the first copious discharges of pus have ceased (necessitating frequent renewal of the dressing) the sinus is covered with a thick pad of wood wool (sublimated) or other antiseptic and absorbant dressing, and this is changed only once each day at first - then less & less frequently according to the amount of discharge. If the pus is putrid 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, boracic acid being the one generally used - and in other cases where there is long continued discharge showing little tendency to lessen the same process is adopted; other solutions, astringent as well as antiseptic being called into requisition. 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 Caley, in the Clinical Societys Transactions Vol X. 1877. page 16. He had a fatal case and he refers to several other cases under the care of continental practitioners (Drs Vallin. Raynaud & Lorey) 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 paracentesis, generally ascribed to embolism from some clot loosened by the alteration in the situations of the bloodvessels, (Dr B. Foster) or to 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 ones now referred to, but these 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 Trousseau, nor by many others, ancient and modern, who not only practised it but effected the entry of the fluid forcibly by means of a syringe. It is evident from my own solitary experience and from Dr Caleys case that the convulsive attack was caused by the endeavour to force a larger quantity of fluid than usual through the sinus. 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 sinus so that one of them might constitute an aperture of exit for the fluid and so prevent any great intra 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 time, - this being the same agent which Dr 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 one great distinction between my case and most others recorded, in that the boy recovered, a result which I attribute to the prolonged administration of chloroform. His empyema at length became perfectly well although the chest was never again washed out.

Case:- Walter Wilkins aet 5. Was admitted into the Liverpool Infirmary for Children (under the care of Dr Greves - to whom I am indebted for permission to relate the case) on October 2nd 1884 - Suffering from left empyema. The pus was escaping from an aperture where it had spontaneously pointed and burst. The "pleurisy" began three months ago and was consecutive to an attack of scarlatina with dropsy. The sinus was at once enlarged and a drainage tube four inches long inserted. This tube was lost in the pleural cavity on October 10th. The chest was washed out daily with a tepid solution of boric acid from the time of his admission until December 4th; he was allowed to be up and about the ward, was placed on a liberal diet and had cod liver oil and Iodide of Iron. The discharges which were sweet, varied in amount, but showed no signs of ceasing, on which account a solution of Iodine (one dram of the tincture to a pint of water) was substituted for the Boracic lotion (Dec 4th). These injections were always siphoned into the chest from a vessel above the bed. The discharge at once began to lessen from the use of the iodine and on December the 17th both the drainage tube and the injections were omitted. On January 5th 1885 the temperature which had previously been normal was noted as having been "high during the last two nights". The breath sound, which had showed

improvement - were rather more plainly audible than on the date when they were previously noted. (Jan 2nd) The left chest was contracted and the percussion note was dull throughout.

January 7th. The temperature continues to rise at night and a slight discharge of pus is taking place from the sinus; this was again dilated and a large escape of pus took place. A tube was inserted and the injections with iodine were resumed.

January 14th. 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 shortened today. Discharges slight.

January 20th. The syphon used for making the injections being out of order, a brass 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 diaphragm was in a condition of strong spasm. Shortly he uttered some loud cries (as though in severe pain) 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 clonic spasm ceased.

Half an hour later - 12 noon - he again went into general convulsions, there was great twitching of the arms & legs, more especially the left, and the face was drawn to the left side. He vomited once while convulsed. 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 3 pm. when he again became convulsed and remained so for half an hour; then came another period of unconscious quiescence, and then another recurrence of the convulsions at 3.45 pm. This time they persisted (in spite of rectal injections of chloral, chrmoide, and other measures) until 4.25 pm. He was in a "status epilepticus", every part being by turns rigid and then convulsed. The temperature in the rectum was normal. He defaecated and micturated unconsciously. The pupils were dilated, especially the left and were insensitive to light. The movements were especially violent in the left side, both in the limbs and trunk and in the face. Chloroform was at this time given (4.25 pm) and under its influence the clonic movements gradually subsided until at 4.40 pm. they had entirely ceased. Chloroform was administered at intervals until 5.55 pm. when it was discontinued - but he soon had a return of the convulsions - violently in the left leg, and slightly in the right arm & hand. The chloroform was again given and was continued until 9.30 pm. up to this time, whenever he came from under its influence the twitchings recurred. At 10 pm. 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 & 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 am.) deranged mentally - says he does not know who I am, 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 sinus)

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 22nd. 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 23rd. 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 pus, blood stained.

January 31st. 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 sinus was still discharging & the side much contracted. Breath sounds weak vesicular. Some crepitations audible throughout.

Later in the year he was again taken into the hospital. Portions of several ribs were 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 empyema of necessity and of cases where there is a bronchial fistula. They are more or less analagous, the latter being a case in which the pus has pointed internally instead of externally. One has often heard it said that a pointing empyema should be incised over the swelling, and indeed it was for long considered that these

cases afforded a better prognosis when so treated, 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 situated anteriorly, close to the sternum) and there is a considerable tendency for them to became chronic. If an ordinary empyema is treated by double incision, one in front and the other behind, the anterior opening will generally close long before the posterior one — when the patient is confined to bed — and the case related at page 82 shows how a chronic empyema, discharging from an anterior wound (originally an empyema of necessity) was improved and eventually I believe entirely cured by making a counter opening posteriorly. My belief is that it is best, where there is an anterior pointing of the pus, to make the usual posterior incision, to ensure thorough drainage as before explained.

Case :- Bertha B. aet 7 years was seized on May 1st 1885 with pain in the side "like a stitch". This lasted for two weeks and was followed by oppression, wasting &c. On June 20th a swelling was noticed on the front of the chest, which increased in size daily. She was admitted to the Childrens Hospital, Pendlebury on June 28th. She was a thin, distressed looking child; her complexion dull and her finger ends markedly 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 tubular in character. The right-side was resonant throughout, Breath exaggerated & accompanied by some rhonchi. The heart beat was visible from the epigastrium to the right-nipple and most plainly palpable in the 4th right-interspace just-at-the nipple. The chest was opened just-below the angle of the scapula on June 29th and eleven ounces of sweet, curdy pus escaped. The anterior swelling had entirely disappeared on

June 30th. The temperature did not rise above the normal after July 3rd but the discharges continued until September 1st 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, if recent, or if there is pneumothorax and continued collection of pus in the chest; but before performing thoracentesis in any of these cases, it is of great importance to be assured of the presence of the pus by means of the exploring syringe.

Double Empyema

Of this condition I have only had 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. Until comparatively recently it was looked upon as of much graver consequence than when unilateral. The older classic writers invariably advised that only one side should be operated upon at first, the other 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 embarrassment (some military records state that wounds penetrating the pleura give rise to collapse of the lungs 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 & Pract: of Physic Ed iv. Vol i p(84) where the healthy side was opened in mistake 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 on opening the chest in the two cases quoted by Watson, in three minutes.
Dr Sidney Coupland and Mr A Pearce Gould published a case of double empyema, cured by simultaneous drainage of the pleural cavities in the Clinical Society's Transactions for 1891; 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 circulatory embarrassment is thus relieved, and the second operation likely to be better borne. In my own case the left side was opened first, the duplex nature of the disease not being suspected until afterwards. An anæsthetic was given (ether) but the cyanosis became so great that when the second incision was made a few days later no ether was administered and the operation was performed with little pain by thoroughly freezing the part with chloride of Ethyl.
The main features of this case have already been related when speaking of cardiac displacements at page 63. and I need only here recall 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 (Wm Winnard Aet 17) was relieved from the dyspnœa of which he had previously suffered.
The fact that when both the lungs have been compressed by fluid, relief, and not distress follows the opening of both pleural cavities, opens up the whole question as to the means by which the lungs become 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

can be observed by the way in which it moves the probe. This gradual expansion of the lung is also proved by the pushing out of the drainage tube; - so that it is certain that expansion does take place whilst the operation wound is unclosed. The exact mechanism by which this is effected requires elucidation by experiment, but some surmise may be made by clinical and pathological examinations. 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 respirations fell, 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 pus caused certainly more oppression 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 promulgated to explain this pulmonic expansion. Some have thought the presence of the dressings on the wound have, by sealing it, or by forming a valvular 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 Wells (Bradshaw Lect: 1857.) who pointed out the coherive force which exists between serous surfaces when in apposition with one another, and which resists very considerable 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, everywhere separated by the fluid; and when the tension is removed, the coughing, and perhaps an involuntary closure of the glottis and expiratory 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 quickly aided by the formation of adhesions; and post-mortem examinations almost invariably prove these to be present to some extent, great or small. There is a record of a fatal case of double empyema in the Pendlebury Abstracts for 1864 (a case which I did not see) where many such adhesions existed. The right chest was incised on March 7th, fourteen ounces of pus escaping. The left one was opened on March 22nd "a little" sero-pus being evacuated, but much more came away later. There was much dyspnoea, unrelieved by keeping the wound covered with pads. There is nothing of clinical interest to record beyond the persistence of hectic, which continued until the child's death on May 18th, aet 5 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 diaphragm to the apex. The pleura was about ¾ inch thick + pyogenic. The lung was well in contact with the chest wall anteriorly. Between the base of the lung and the diaphragm was a separate cavity containing pus. The pleura was adherent to the pericardium.

Left Lung:- was adherent anteriorly as low as the 3rd rib, as well as throughout posteriorly, but laterally there is a cavity reaching up to the apex (by these cavities - non adherent portions of the pleura are accidentally meant) The upper lobes of both lungs were fleshy and quite airless. The lower

lobes ordematous, tough and containing little air.

The following abstract from my own notes, is from a case which is perhaps more instructive, since the child recovered from the empyema, but died of croup eight weeks later. The sinus was entirely healed on November 21st 1884 and it died on Jan 14th 1885.

Case:- Martha Pickthorn aet 14 months had been ailing since an attack of measles three months before she came under observation on Sept: 21st 1884. when she was found to have a right-sided empyema. This was opened and freely drained, after which she speedily improved in health, so that whereas she was at first so weak as to be unable to sit-up, and only weighed 7 lbs 6 ozs; after four weeks her weight had increased To 13 3/4 lbs. The chest was washed out daily, at first with tepid boracic lotion; but by November 1st the discharges had abated and on Nov: 13th the tube was left out. The pus however re-collected, necessitating the reintroduction of the tube a couple of days later, but on Nov: 19th it was finally withdrawn and by Nov 21st the sinus was healed. The breath sounds remained indistinct on Nov 30th and the percussion note was dull all over the right base posteriorly; but this dulness had greatly diminished and the vesicular breath sounds were plainly audible at the time of her discharge from the hospital on December 29th On January 14th 1885 the mother called to say that the child had been seized with croup and had died that morning. I made a post mortem at the house 24 hours after death:- Rigor slight except in jaw. There was little hypostatic lividity. Body fairly nourished. The Sinus was entirely healed up, its situation being marked by a broad, smooth cicatrix. The Blood 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 extent in the mid axillary line. The right lung was somewhat solid, and of a purplish-slate colour towards its base; this part floats in water (probably an area not yet recovered after the emphysema) The upper two thirds was crepitant and on squeezing much frothy exudation took place from the cut surface. Left Lung healthy. A thick layer of false membrane lined the whole extent of the trachea and larynx; the cords were thickened and covered with false membrane. There were no glandular enlargements. The mother stated that the "croup" had existed for three days. (Diphtheria was prevalent at the time).

Before taking leave 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 Southern Hospital during the past five years. I am aware that the principle has been adopted several times previously, but the practice as carried out at the above hospital differs in its details from many of the previously tried methods, and the results when care is taken to maintain asepticity have been highly satisfactory. I refer to the plan introduced among us by D. W. Williams, one of the physicians. The procedure is as follows:- A carefully purified trocar and cannula (the latter having a bore which just allows a rubber tube, presently to be referred to, to pass through it) is pushed 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 insure that no air enters. A long rubber tube (having a diameter of about 3/8 inch) filled with boric lotion, and taken direct from a bowl of the same is then quickly pushed through the cannula during an expiration 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 perforation, surrounded by a collar on its convex side, onto which a piece of rubber tubing is pulled, 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 flap valve, which allows the egress of fluids from the chest but will neither permit air nor liquids to pass upwards. This is kept submerged 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 siphoned 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 septic 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, my choice of operation would be in favour of free incision

— References —

(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 these they become affected with empyema" (The Genuine Works of Hippocrates — Francis Adams — Sydenham Society 1848-9).

(2) Prognostics § 7. "A swelling in the hypochondrium that is hard and painful, is very bad provided it occupy the whole hypochondrium; but if on either side, it is less dangerous when on the left..... But if the fever continue beyond sixty 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 II page 195.

(4) Aph: 27. Sect VI. "Those cases of empyema or dropsy which are treated by incision or the cautery, if the water or pus flow rapidly all at once, certainly prove fatal. (Gen: Works of Hipp:- Adams. Syd Soc).

(5) "Et hæc quidem incisione curantur" (De locis in homine sect IV. — Hippocrates - Opera omnia quæ extant in vij sectionibus ex Erotiani recensione distributa, nunc recens Latina interpretatione et annotationibus illustrata, Auctus Foesio. Franc 1595.).

(6) "Aqua intercutem laborantes cito mictare oportet, tabescentes confestim urere, caput siccare. At ista in aqua intercute suppressis animadvertenda sunt; nec cujus venter aut interiora pecco contingantur. Perinde enim ac in multis generibus accidit" (ibid. De morbus vulgaris - lib VI sect 7. No 8.

(7) Vid aphorism 27. Sect VI = reference No 4.

(8) Vid Commentary on above aphorism — in Gen: works of Hipp:- Adams. Syd Soc.

(9) "Quod si propter crassitudinem humor non fluctuet, neque strepitus edatur in pectore, credamus autem spiritum trahat, pedes intumescant, & tussicula quaedam veniat, ne decipiaris videro, sed scito thoracem pure plenum esse. Linteo itaque tenui in rubrica liquida admodum trita & tepida intincto, thoracem inorbem, obtegito, quaque parte primum pesiectum fuerit, ea sectionem aut ustionem facere oportet, ut quam proxime ad septum transversum accedas, ea tamen adhibita cautione ne ipsum attingas" De Morbis Lib III. page 496. Ed: Antio Foesio - 1595.

(10) "At si prae crassitudine & copia nullum tibi strepitum edere videatur quo ipsum deprehendas, quod sit interdum, latus ~~quod~~ intumuerit magis dolueritque quam infima parte sub ipsum humorem potius quam anteriore parte secato, quo facilior puri exitus pateat. Primum autem inter costas cutem speculo lato excisorio secato, deinde speculo acuto paruulo delegato, cuius extremam partem unguis pollicis magnitudine relictam intro adigito. Patet ubi quantum puris videbitur emiseris rudem penicillo en lino crudo cui filum alligaris obducito, quotidie pus semel emittito ..... At ubi pus tenue velut aqua, aut ad digiti contactum glutinosum & paucum fuerit, stamineum penicillum carnem indito" &c &c. De Morbis Lib II page 476. - Ed Antio Foesio.

See also De intern: affectionibus Sect V. p 536.

(11) "Quod cum intellexeris, tertiam ab ultima costam ad os usque secato deinde ferrea acuta ulterius perforato, cumque perforata fuerit, paucum aquam educito. Lana educta penicillum en lino crudo in vulnus immittito & molem spongiam superapponito deinde ne penicillus decidat delegato per duodecim autem dies, semel die aqua educenda, post duodecim vero die decimotertio die tota aqua educenda, & de caetero; si sus-citetur aqua emittenda, venter; cibis siccis rescecandus" &c &c. De Intern: affectionibus Sect V p 544.

(12) Celsus. Lib VIII cap IX — Translation of eight books of Celsus by G. F. Collier. 1831. — pp 344 — 345. — 346.

(13) Galeni Methodi Medendi Lib V. Cap VIII. De ulceribus pulmonis ac sanguine de pectore erumpente :— "Nos vero in iis, quibus erat in pectore lateris abscessus, ut etiam ossium aliquid carie corrumperetur, manifeste ipsis ostendimus mulsam, quae injecta in pectus fuerat, ex pulmone expui. Sane novimus in urbe Roma (——) ejusmodi affectus in pectore non paro constitisse, ut necesse fuerit ipsum os, quod affectum fuerat, excidere &c.

(14) Paulus Aegineta — translated by D Adams. Syd. Soc. Lib VI. cap 44.

(15) See also Le grande Chyrurgie de Maistre Guy de Chauliac. Transl:- Maitre Simon Mingé - Lausanne 1672, — page 218. "Pourtant Haly Abbas au discours neufieme de la disposition Royale tient l'incision & la cauterisation faite avec le fer pour suspectes et douteuses parce dit il qu'on ne guarantie pas le malade de la mort, ou que pour le moins il se fait une fistule qui ne guerit jamais; c'est pourquoy avant faire cet operation il faut se precautionner contre toute sorte de reproches par le moyen des prognostics; et cet auteur rapporte une autre maniere de cauteriser la partie; il l'execute avec la racine d'aristoloche longue brûlante, & avec l'huile bouillante" &c
De Chauliac wrote about 1580.

(16) Vid — a remark by the translator of Guy de Chauliac " Par cette application du cautere on oste à la partie le sentiment, car elle demeure bruslée, & l'escarre venant a tomber, & l'overture est plus long temps a se fermer, & on n'est pas oblige de la dilater par les tentes, ce qui est tres douloureux" &c.

17 e.g. Guy de Chauliac — Chirurg. Magna: "Dans les playes penetrantes du thorax, si on connoit par les signes desia proposez qu'il y ait quelque matiere epanchée dans sa capacité qu'on la vuide sans aucun retardement et conformement au conseil de Galien qu'on ait soin de dilater la playe afin que le sang ou le pus ou les serositez puissent sortir à l'aise & comme à plain

canal: on vient à bout de cette intention, si on met une tente dedans la blessure qui soit faite avec industrie, c'est a dire qu'il faut qu'elle soit large & presse par la bout qui doit demeurer en dehors afin qu'elle ne puisse pas tomber en dedans ------ & avant l'introduire dedans on la trempera dans l'huile rosat, pour faire sortir la matiere &c &c ------ si le blessé n'a pas souffert l'injection ny que l'evacuation de la matière ne se soit pas bien faite & que cependant il sente une grande pesanteur au coste, qu'il ait enflure ou eminence, ou qu'on ait des signes qui facent juger qu'il y a des matiere assemblée sur la reduplicature du diaphragme, S'il est vigoureux voulant permettre qu'on execute ce qu'on doit tanter dans des pareilles occasions, Guillemeau conseille de faire avec un bistory une nouvelle overture dans la partie inferieure & pendante du coste malade tirant vers l'espine ------ entre la 4ième & 5ième coste ou entre la troisieme & la quatrieme; mais parce que cette reduplicature du diaphragme se fait dans l'endroite ou il est contigu aux costes & a l'espine jusques pres de la troisieme & au dela d'icelle pourroit empescher la sortie de la matière & faire croire au chirurgien qu'il n'a pas assez profondé avec son bistory, il vaut mieux faire l'overture entre la quatrieme & la cinquieme qu'entre la troisieme & la quatrieme &c &c.

(N.B. the interspaces were counted from below upwards)

(18) Translator of M. Chauliac "ordinairement on la fait dans la partie posterieure & laterale à quatre ou cinq travers de doigts de l'espine à cause des corps nerveux qui en sortent" - page 221.

(19). Paré Introduction to Surgery 1579

CHAP. X.

Of the Pleuriſie.

What it is.

THe Pleuriſie is an inflammation of the membrane, inveſting the ribs, cauſed by ſubtile and cholerick blood, ſpringing upwards with great violence from the hollow vein into the *Azygos*, and thence into the intercoſtall veins, and is at length powred forth into the emptie ſpaces of the intercoſtall muſcles, and the mentioned membrane. Being contained there, if it tend to ſuppuration, it commonly infers a pricking pain, a Feaver and difficulty of breathing. This ſuppurated blood is purged and evacuated one while by the mouth; the Lungs ſucking it, and ſo caſting it into the Weazon, and ſo into the mouth, otherwhiles by urine, and ſometimes by ſtool.

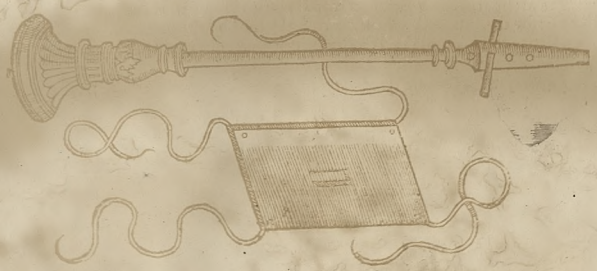
Of a Pleuriſie come to ſuppuration.

Of the change thereof into an *Empyema*.

Of the aperition of the ſide in an *Empyema*.

But, if nature being too weak, cannot expectorate the purulent blood poured forth into the capacity of the cheſt, the diſeaſe is turned into an *Empyema*, wherefore the Chirurgeon muſt then be called, who beginning to reckon from below upwards, may make a vent between the third and fourth true and legitimate ribs; and that muſt be done either with an actual or potentiall cautery, or with a ſharpe knife drawn upwards, towards the back, but not downwards, leſt the veſſels ſhould be violated which are diſſeminated under the rib. This aperition may be ſafely and eaſily performed by this actuall cautery; it is perforated with four holes, through one whereof there is a pin put higher or lower according to the depth and manner of your inciſion, then the point thereof is thruſt through a plate of Iron perforated alſo in the midſt, into the part deſigned by the Phyſitian, leſt the wavering hand might peradventure touch, and ſo hurt the other parts not to be medled withall. This ſame plate muſt be ſomewhat hollow, that ſo it might be more eaſily fitted to the gibbous ſide, and bound by the corners on the contrary ſide with four ſtrings. Wherefore I have thought good here to expreſs the figures thereof.

The Figure of an actuall cautery with its plate fit to be uſed in a Pleuriſie.



But if the patient ſhall have a large body, Cheſt and ribs, you may divide and perforate the ribs themſelves with a Trepan; howſoever the aperition be made, the pus or matter muſt be evacuated by little and little at ſeverall times; and the capacity of the Cheſt cleanſed from the purulent matter by a detergent injection of vi ounces of Barley water and [illegible] honey, and other things mentioned at large in my cure of wounds &c.

(20) Hieronymi Fabricii ab Aquapendente Opera Chirurgica 1647.

Extracts from Cap: de Thoracis sectione in Empyemate

"Igitur cum nec per tussim cum vocatis Lambitivis, neque per urinas cum urinam cientibus, neque per alvum cum purgatoriis exhibitis, neque tandem per ea, quæ Hippocrates plurima præmit-secundo de morbis, cap: de suppuratis ea perspicuissima, Thoracis collecta evacuari posit, tunc accedimus ad manuariam operationem, hoc est chirurgicam, quæ est Thoracis perforatio, ut aqueum ex præcipite levemus. Quæ sicuti antiquitus frequentius, et tutius usurpabatur, ita his nostris temporibus videtur obsoleta, sicuti fere omnes aliæ chirurgicæ operationes essatu dignæ. Puto ego quia non reperiantur eximii chirurgi,

secuti decerent, qui callerent anatomen, & tuto noverint perforare & id genus omnes operationes tuto molirii, sed formidolosi sunt. Sed causa est, quia antiqui forte plerima audebant & tentabant in robustioribus corporibus. Iertie quia temporibus nostris aegri tenuiori patientes sunt et delicati, ut non admittant egregia istius modi opera, ultima est periculosum, quod incurrimus offendendo alicuius momenti partes. Duo mihi in praesentia cupio vos tutissime hanc operationem perforandi thoracem docere."

"Vitamus deinque partium externarum laesionem, venarum scilicet arteriarum, nervorum, & musculorum quae si laederentur, omnino operationem minus tutam redderent, si incidamus in superiore ipsius costae partes, nequaquam in inferiore. Cumque inter quintam, sextamque costam perforatio facienda sit, adeatque in hoc spatio & pars inferior quintae & superior sextae, ideoque omnino vitanda sit inferior costae pars, seu terminus; Ad superiorem sextae costae partem efficienda sectio est, quia per inferiorem quintae costae partem at anatome comonstrat, & Gal: & De anat: adm. monet incurrunt vena arteriae & nervus, sta enim non modo has partes vitamus, sed etiam harum partium propagines quod utique non accideret, si alibi quam prope sextam costam perforaretur. Nam in inferiore parte quintae adsunt hae partes, in intercostali vero spatio medio harum partium propagines horum autem neutrum adest in superiori sextae costae parte in qua tuta sit perforatio, si modo, costa incisione non allungatur, aut denudetur".

"Ultimo efficienda sectio est ad latus. Quaeritur modo qua in lateris parte? Hippocrates in suppuratis duo prospicebat partem affectam, & situm declivem; ideoque aliquando praecepit posteriorem potius sectionem efficiendam esse; At in collectione aut pituitosa aut aquea, qua causam a thorace non habet, sectionem anteriorem moliri satius est quia musculi pectorales sunt; & terminantur, nec non pulmo finitur,

quam posterius, ubi musculi superpositi, & plures & crassiores, & magis nervosi spinaeque propinquiores sit. Regio enim anterius spectans, exempli gratia, quatuor aut quinque digitos longe a pectoris osse distans, parvos habet musculos, et paucos superpositos ferèque non nisi unum, qui brachium ad pectus adducit, qui etiam ibi tenuiorem habet terminum, ideoque potius anteriora quam posteriora versus fieri debeb sectio. Alia ratio est, quia posterius pulmones sua basi consistunt, tum vero musculi multi & nervosi, utputa spinales adsunt"

"Itaque sectiones locus qui differt secundum anterius & posterius sit, ubi musculis est vacuus, & destitutus idest ubi omnium musculorum termini sunt, videlicet adducentis brachium ad pectus, obliqui decendentis abdominis & in semis scapularum siti Thoracem attollentis. Exactissime autem locum invenies, si filo metiens spatium, unam fili partem a medio pectore ad costam sextam & sesquialteram, hoc est, unam cum demidia ab illo sextae costae termino ad spinam dimetiaris. In summa, quo pertingit tertia pars fili totius sextae costae longitudinis".

"Maximum autem in hac operatione imminet periculum, ne tota materia collecta nobis invitis vice consertim exeat, cum qua exeunt etiam spiritus viriumque debilitas tanta succedit ut Hipp: 6. Aph 27. dixerit. "quicunque empyemi aut hydropici uruntur aut secantur, si pus aut aqua universim effluerit, omnino moriuntur". Ob quam causam ego imaginatus sum cannulam argentam, quae adeo magna sit ut exacte incidenti instrumento, & foramini respondeat, ita ut quantum nobis libeat aquae evacuetur non plus &c &c - - - - - - Facta perforatione; & immissa cannula, quae habeat alas aut filum appensum, ita ut intra Thoracem inspirando non ingrediatur, & sit plurimus foraminibus perforata ut posit ex omnibus prout opus est, exire colliquies. Ejus sit longitudinis ut ad opus perveniat, non tamen pulmones tangat: Curva sit vel oblique intus incedat pone costam propter eandem causam, immittatur; deorsum

instrumenta curentes diaphragma versus ne pulmones ab extremitate eius tangantur". (20a) page 54 "Quae vena omnino debitabitur, si in statu expirationis aeger consistat, dum fit incisio" &c.&c.

(21) Gregorius Horstius – Operum medicorum – Tomus Tertius.

Questio V. – II. "Verumtamen cum thoracis vulnera tantum saniem quotidie effundant, quantam vix in aliis deprehendere licet, propterea quod natura tam propter conservationem partis, quam ob dolorem plurimum sanguinis quotidie eo transmittat, qui malignitate & sordibus inquinatus, aut ob partis imbecillitatem non alteratus, citissime corrumpitur. Adeoque potius cum negante parte consentimus quae statuit talia vulnera diu aperta esse debere, ut sanguini corrupto & saniei patet exitus, non enim negandum quin retentus ibi praeter naturam sanguis, vel humor quidam corruptus, majoris mali causa reddatur."

Guilhelmi Fabricii Hildani Opera observationem & curationum.

Observatio XXXVI De vulnere pectoris cum pulmones laesione Gregorius Horstius &c. &c. Centuria III

Quaest IV "Sed miratur fortasse aliquis cur statim brevissimo hoc tempore spe consolidationis faciam aegro, cum tamen non pauci sint in ea opinione, vulnere thoracis diutissime aperta esse debere; nimirum quae maximam partis copiam prae reliquis quotidie fundunt. Hinc igitur secunda dubitatio sequitur an haec vulnera diutius aperta esse debuerint. Negative respondeo, quia non necessarium esse videtur diutius vulnera pectoris à consolidatione defendere, quando nihil purulentae materiae, vel thromborum sanguinis in cavitate pectoris continetur, quod pluribus demonstremus in cent. prob. Therap. dec V. quaest V. Contrarium vero veritas concedimus tunc temporis, ubi materia purulenta, in ipsa cavitate thoracis etiam colligitur; In quo casu non tantum aperta relinquenda sunt vulnera, sed simul etiam per injectiones dejectivis, abstersivis aliisq; medicamentis naturae succurrendum esse putamus" &c.&c.

In Quæstio X (page 61). Hoffman makes a statement which evidently refers to the case of Jason Pheraeus - who is reputed to have had an empyema which was pronounced incurable. He entered in a combat - seeking his death - but the enemy's weapon pierced his side & the matter escaped so that he recovered - I append a quotation from Henry Vaughans translation of Plutarchs "of benefit from enemies" (Grosart).

"For as that enemie of Prometheus by running at him with his sword to have killed him broke only the imposthume in his body, and so cured him; in like manner an evill word spoken, sometimes out of anger or enmitie, may cure some ulcer in our manners, which either we knew not of before or else neglected"

The same history is referred to by other classic authors

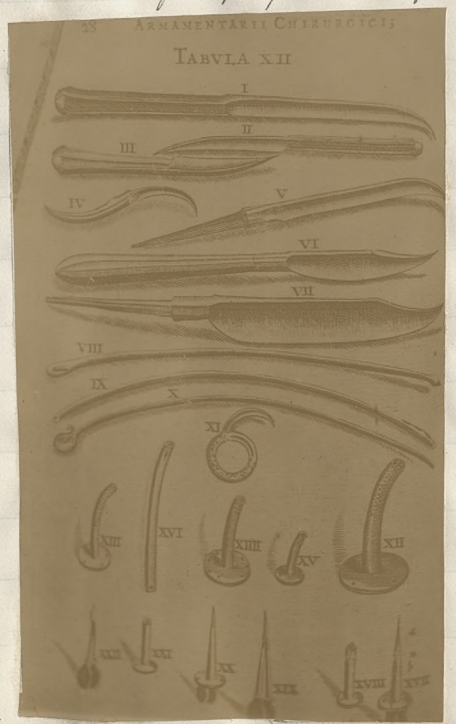
(22) See Haller. Biblioth: Chirurg Volt I pag CCLXXXI. "Monet ne vulnera pectoris præpropere claudantur" also Marchettis. - Observationum medico-Chirurgicarum rariorum Syllogæ &c. vid Observatio XLV entitled De vulnere in thoracis cavum penetrante imperito, perperam viginti dies obligato febris, tabes corporis macies, cum deliris suborta, a suppresso pure, quo expurgato, omnia pernicissa, sanato ægro &c. &c.

(23) An Account of the Diseases, Natural History, and Medicines of the East-Indies - translated from the Latin of James Bontius - physician to the Dutch Settlement at Batavia - Date of dedication in this book = 1629. He says "and yet - there is no other passage for the discharge of the matter than the trachea arteria, whatever people may affirm of it - being frequently carried through the left-ventricle of the heart into the liver and mesenaic veins & thence discharged critically in the course of the circulation either by purulent stools or urine - - - - - I never was so fortunate as once to see such an excretion. But the method of cure I am now to propose though not quicksilver somewhat ticklish and precarious, will certainly be acknowledged by every judicious person to be the most

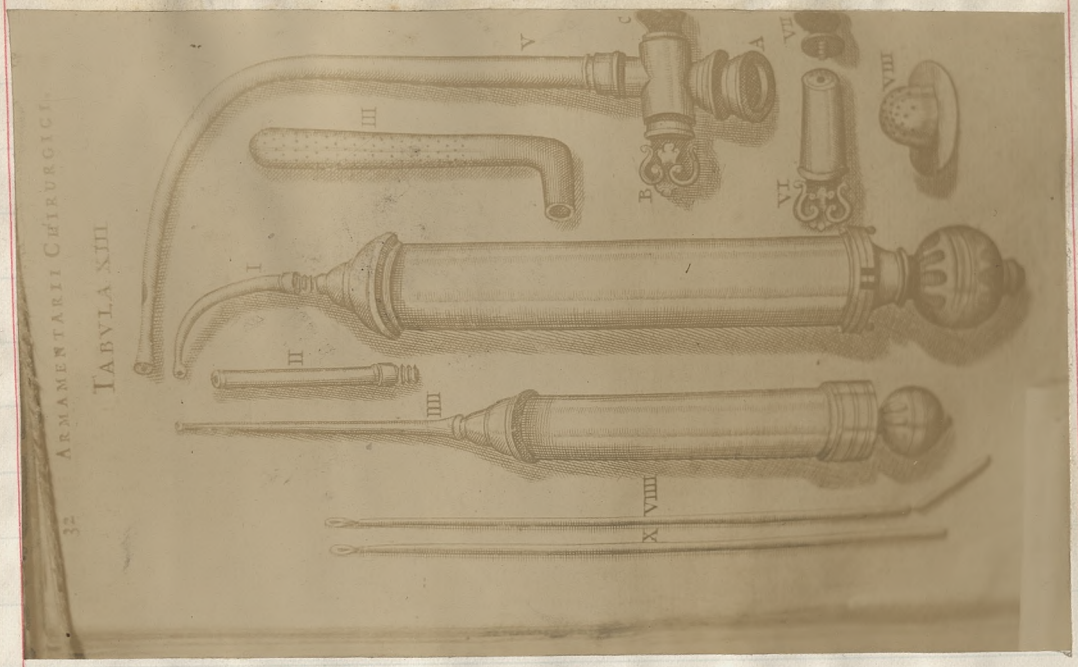
excellent & effectual resource". (The pus was commonly supposed to be vivified by time &c. Vid Dr Chandler Ch 219)
"many have I known surprisingly cured by this remedy; among whom are a serjeant & a corporal in the Dutch garrison, who ever since, when I meet them, perfectly harass me with their kindness and thankful acknowledgments."

(24) Haller. Bibliotha: Chirurg vol I pag CCLIV. "In libello de pulmonibus suadet, in paracentesi digitis cultrum segui, ne in pectus aër irrumpat"

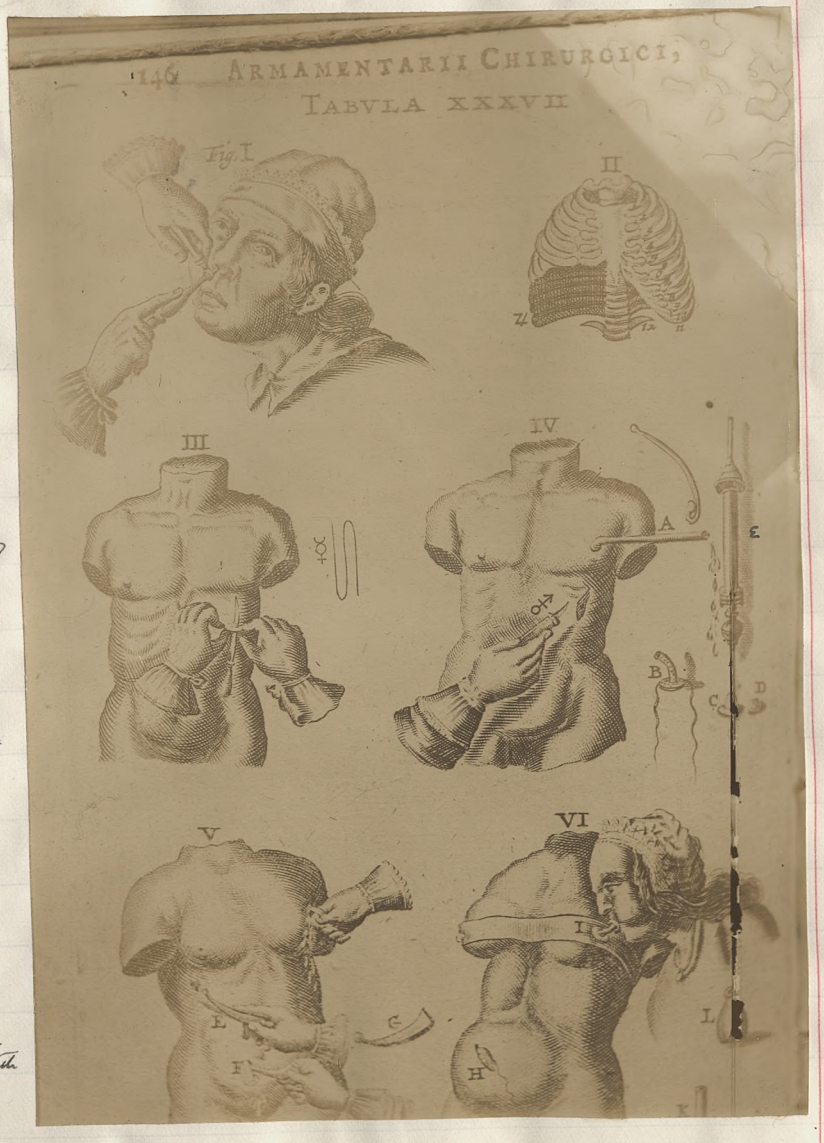
(25) Armamentarium Chirurgicum. Tabulae XXXVII declaratio.
"..... deinde cannula argentea (Tab huius fig IV B indatur) ut liquor mane vel vesperi impurus, emitti possit: quod enim mane in thoracem impenditur, ad vesperam evacuetur, quod vero vesperi, mane".
"In materia tamen aquosa, vel pure tenui, statim post apertionem thoracis foramini imponatur cannula exacte respondens, & cannulae penicillus filo alligatus, ne aqua vel pus tenue universum effluat, & aegri morientur (monente Hypp. Sec 6. aph 27) sed ut tantum materiae, quantum virium ratio permittit, evacuetur. Quod. si ob aëris frigiditatem aliamque causam, consultum non est, ut quotidie semel vel bis, materiae detur exitus, cannulae spongiola (Tab huius fig IV D.) imponatur, pilcolusque (Tab. huius fig IV C) addatur ut materia omni quasi momento per ejus foramini, paulatim & circa virium jacturam, transmittat"



Various knives, cannulae &c used for thoracentesis



Tab XIII – Syringes & trocar & curved used by Scultetus.



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 strings for fixing. C & D = tenter

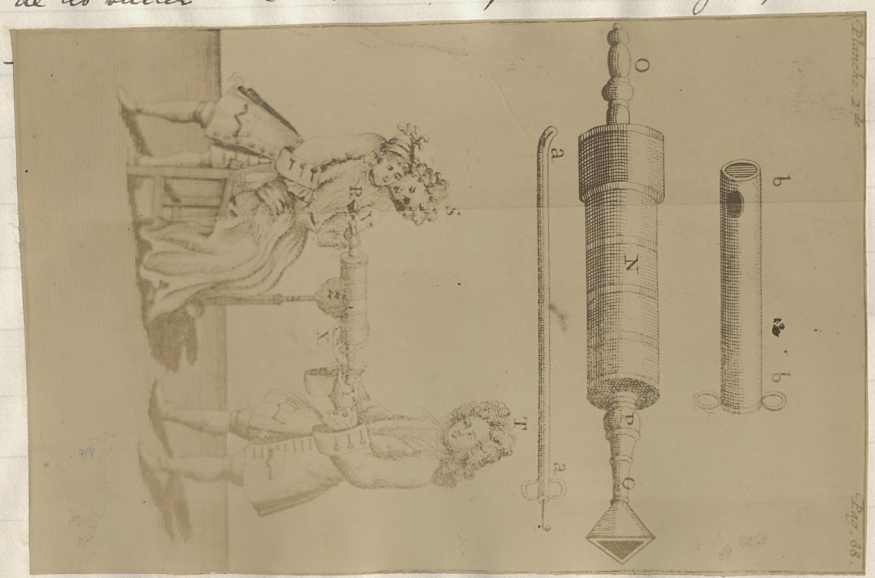
Fig V. E = knife with probe point – used for incising pleura after incision of muscles or with sharp pointed knife.

(27a) A. Ruck. Operationes & Experimenta Chirurgica (Lugduni Batavorum apud Cornelium Boutesteyn 1692) Experiment. XXXI. p 113. "In Hydrope Pectoris si fluidior fuerit aqua, simpliciter acu minori perforatis instituenda. Si vero minus fluida, major acus in usum vocanda, uti infra in Abdominis Paracentesi explicaturi sumus: nulla siquidem obesse videtur ratio cur non aeque hoc in loco, quàm in Abdomine talis perforatio locum habere posset." See also Sprengel. Hist. de la Med. T IX p 29

(26) Vid Trousseaux's Clinical Med: Syd. Soc. Vol III page 207. Also. Sprengel - Histoire de la Médecine. Tome IX. p. 29.

(27) La Faye Dionis — Cours d'operations de chirurgie par M. Dionis 4me Ed. Revûe par G de la Faye 1740. Dionis only recommends the trocher for hydrothoran. He employed the knife where there was pus. He mentions the cautery but objects to it because it tends to destroy the muscles & coverings of the ribs — because it makes so large an aperture that a cannula afterwards doesn't fit properly vid pp: 438-9.

(28) Dominique Anel — L'art de succer les playes sans se servir de la bouche d'un homme 1707. "Quelquefois on peut pratiquer cette methode de succer, a des corps d'epée qui penetrent dans la capacité du thorax et qui le percent meme d'outre en outre ..... L'on peut, dis-je, a la faveur de cette sonde, qu'il faut introduire dans la playe en suivant son trajet, succer non seulement le sang repandu dans le trajet, mais encore la matière et le sang repandu sur le diaphragme, pourveu que l'un et l'autre soient encore liquides ..... Quand on est convaincu de l'empieme dans les playes de poitrine par des signes univoques, il faut en prevenir l'operation du meme nom, en pratiquant le method de les succer avec la Sonde de poitrine dont j'ai parlé ci devant. —



(29) M. Guillaume Mauquest, Sieur de la Motte — Traité Complet de Chirurgie - Paris 1722. Eg. Observation XXVII "Au mois de Mars 1696, je fus prié le soir d'aller chez un Rôtisseur de cette ville, pour voir un soldat du Regiment de Beuge, qui étoit blessé d'un coup d'epée en la partie anterieure de la poitrine, entre la cinq et la sizieme des vraies côtes inferieures, assez près de leur union avec le sternum. qui penetroit au dedans de la capacité, et lui causoit une oppression si violente, qu'il étoit pres d'expirer. Le vicaire étoit auprès de lui, qui refusoit de lui donner les sacremens à cause qu'il fait passer du secret, qui selon ces messieurs les Docteurs n'opere que par art magique, auquel il faut renoncer comme à Satan et ses pompes, autrement point de Salut.

(30) L. Heister. General System of Surgery 1748 (Translation) "The utmost diligence should be used to guard the contents of the Thorax from the external air. At the time of dressing a chafing dish of hot coals should be held near the wound to warm it, then the air, if too great a quantity of air is already got into the cavity of the Thorax it must be drawn out with a Syphon &c. &c.
See also De La Motte. Traite de Chirurg Tom II page 291.

(31) De la Motte. Traite de Chirurg Tom II page 297. "Je ne me servis pas d'injections ni recommandées des anciens dans les playes de poitrine, ne voiant pas que leur usage me pût être d'aucun recours" &c. &c.

(32) See. Sprengel. Hist. de la Medicine Tom IX page 30.

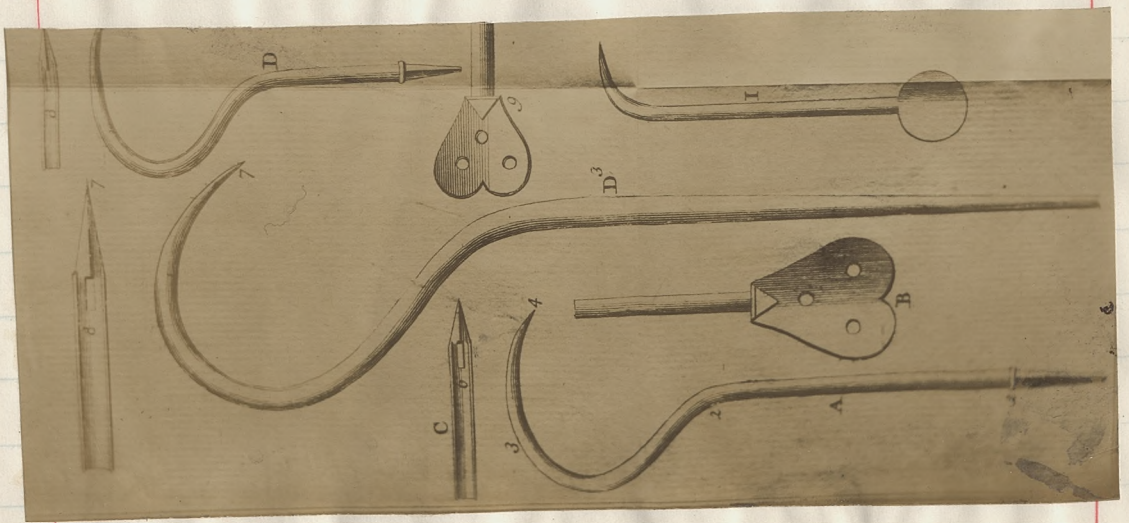
(33) Samuel Sharp F.R.S. - a critical enquiry into the present state of Surgery 1750.

(34) Gerardi van Swieten — commentaria in Hermanni Boerhaave Aphorismos, de cognoscendis et curandis morbis. Tom Primus - 1752.
"Si jam pulsus sit satis fortis et aequabilis, calor ad externa corporis usque adsit, nullus sinultus, nulli spasmi appareant, et urinam simul adsit constantia, novimus cessare internam haemorrhagiam, et tuto tentari posse illa arcentis molimina, quae requruuntur ad eductionem sanguinis in cavis thoracis haerentis." &c &c.

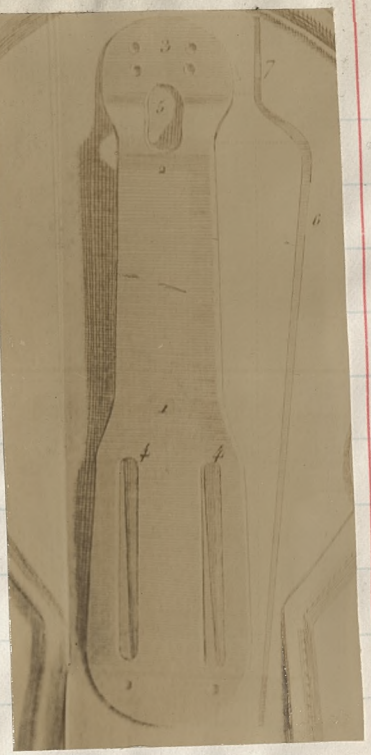
(35) Vid Kurt Sprengel — Histoire de la Médecine - traduite par A.T.L. Jourdan. pp. 59—60. T. IV.

(36) For reference regarding Gerard method see Cours d'operations de chirurgie par M. Dionis 4ème Ed. revue par G de la Faye. 1740. Footnote page 425. article De l'Empyeme.

(37) Memoire de l'Academie Royale des Sciences 1740. De l'Aiguille a manche pour la ligature de l'artere intercostal par Mr Garlard. 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 Garlard memoire.



(37) Description of this instrument of its method of applying it in the Memoires de l'Academie Royal de Chirurgie Tom III 1819. Vid:- "Histoire" at commencement of Volume. page LXIV. - photograph of instrument — anterior & lateral view — attached.



(38) Belloc's memoire is contained in the above volume of the Memoires de l'Academie Royal de Chirurgie. He also mentions other methods of arresting intercostal hemorrhage.

- Belloc's Instrument -

(39) - Sprengel - Histoire de la medecine - Tom IX. page 40.

(40) Trousseau - Clinical Medicine - Syd: Society. Vol III page 207.

(41) Traité des Maladies Chirurgicale - par Chopart et Desault. (Tome quatrième de la republique). Cap - Des Maladies de la Poitrine page 71 :- "On donnera promptement issue a l'eau épanchée dans la poitrine, accumulée en grand quantité a la suite de la pleuresie, de la pongeole ec., et qui cause suffocation, en faisant l'operation de l'empyème: La ponction alors conseillée est dangereuse et souvent insuffisante. L'operation de l'empyème toujours préférable."

42. G. van Swieten. comment in Boerhaave. aph: vol I parag: 304. Thoracis Vulnera. " alterum, quod hic requiritur est, ut aër arceatur, ne per vulnus in cavum pectoris ingrediatur; vel si ingressus fuerit, inde ejiciatur. Quamdiu vulnus extravasatu liquida ejecta sunt ex pectoris cavis, impossibile est aërem arcere cum liber exitus pateat humoribus effusis; et seq.....

(43) Memoir de l'Academie de Chirurg: 1819. Tom II page 386. Morand, sur une hydropisie de poitrine - guerie par operation "Je conclus de cette remarque qu'il est necessaire de ne point évacuer à la fois toute l'eau épanchée, et qu'il seroit peut être plus prudent de ne faire l'overture de la poitrine en forme, qu'après un ou deux ponctions, pour permettre au poumon une expansion douce et graduée."

(44) Samuel Sharp FRS. - a critical Enquiry into the Present State of Surgery 1750.

(45) Joseph Warner FRS. Cases in Surgery 1754.

(46) The operations in Surgery of Mons Le Dran - Translated by Hus Salater. Surgeon Lond. 1749. page 210.

(47) Vid Coopers Surgical Dictionary 1825. page 434.

(48) Cyclopaedia of Practical Medicine — 1833. Article on Emphysema. Tourtual.

(49.) Practical Operations in Surgery. 1803. by Wm Hey F.R.S.

(50) System of Operative Surgery by Charles Bell 1807-9

(51.) Vid Trousseau. Clin: Lects. Sy. Soc. Vol III page 207. Also. Dictionnaire des Sciences Médicales — Art Emphysème p 91 ac ⁊c. (1815.)

(52) Memoires de Chirurgie Militaire et Campagnes de D. J. Larrey 1812.

(53) Cyclopaedia of Practical Medicine 1833. — Article on Emphysema - Tourtual.

(54) Vid Dictionnaire des Sciences Medicales page 58.

(55) Memoire sur une operation d'Empyème de pus; Journal général de médecine Tom XLVII p 121. (Dict. des Sciences Med. page 58).

(56) Trousseau. Clin: Lectures. Sy. Soc: Vol III page. 192.

(57) {Memoire sur la pression abdominale comparée avec la Percussion thoracique par M Roux Paris} Vid Dict: des Sciences Medicales.

(58). {Translation of Auenbrugger 1808.} also. Essai sur les Maladies et les Lesions organiques du Coeur et les gros vaisseaux. J. N. Corvisart - 2nd Ed. 1811.

(59) De la Percussion Médiate, et des signes obtenus a l'aide de ce nouveau moyen d'exploration dans les Maladies des organes thoraciques et abdominaux par P. A. Piorry. Paris 1828.

(60) Treatise on the Diseases of the Chest and on Mediate Auscultation, by R. T. H. Laennec. Translated by John Forbes M.D. Ed 3. 1829.

(61) Sprengel - Hist: de la Médecine. Tom IX. page 21.

(62) Medico Chirurgical Review 1826.

(63) Vid Stokes on Diseases of the Chest (D Hudson). Syd: Soc. page 506 - footnote. See also Rudral - Clinique Medicale p604 - footnote for description in Reynaud's own words.

(64) ibid p 509 & seq - - -

(65) Coplands Medical Dictionary - 1858. Art - Diseases of Pleura.

(66) Quoted by Trousseau from Sanjot - Arsenal de la Chirurgie Contemporaine. Paris 1867. Both Schuh and Reybard appear to have invented their instruments in the same year, 1841. (66a) In this year also he devised his operation by paracentesis pericardii - Gazette Medicale Jan 16 - 25: 1841. Vid Trousseau. p 269. Volume III

(67) Pathology and Diagnosis of Diseases of the chest by C. J. B. Williams Ed 4. 1840.

(68). Trousseau Clinique Medicale. Syd. Soc: Vol III page 234.

(69) Dieulafoy. De la Aspiration Pneumatique sous-cutanée. Methode de Diagn: et de Traitement. Masson. Paris 1870.
Professor Smith — exhibited his aspirator at - B. Med. Assn Meeting, in Dublin 1867.

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

Dictionaire des Sciences Medicales 1812. Article - Empyème - Rullier
" " " " - Pleurisie - Chomel

Recherches sur la Phthisie Pulmonaire. par G. L. Bayle 1810.

An Enquiry into the Nature, Causes & Cure of Hydrothorax. McLean. 1810.

Walsh. Diseases of the Lungs & Heart. 2nd Ed. 1854. Also 4th Ed. 1871.

Watson. Principles & Practice of Physic. Ed. 4th 1857. Also Ed 1843.

Graves. Clin: Lectures. Syd. Society — 1884.

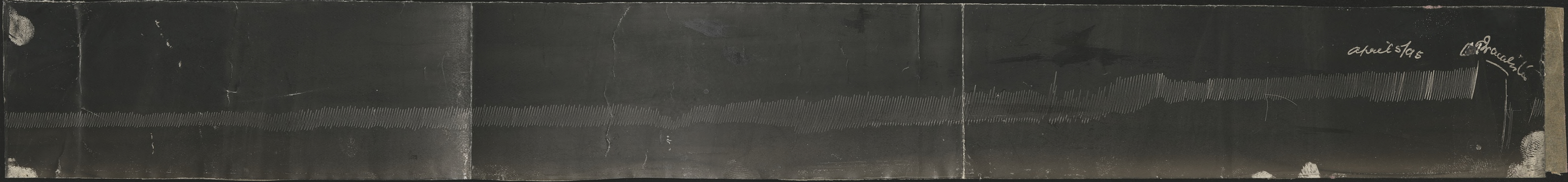
Principles of Military Surgery — John Hennen M.D. 3rd Ed 1829.

and numerous references to the Lancet. British Medical Journal. Medico Chirurgical Review. Johnsons Medico Chir: Review &c. &c. &c.

Douglas Powell — * Diseases of the Lungs 3rd Ed. pages 13—17.

** 2 & 2 — page 97.

*** Cunninghams Anatomy — Relations of pleura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