A Contribution concerning Paracentesis.

With illustrative Cardiac, Pulmonary, Pleural and Renal Cases.

Being a Thesis for the degree of M.D. by

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Akaroa,
New Zealand.
16 January 1897.
Thereby declare upon solemn and conscience that this Thesis for the degree of M.D. is entirely my work.

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A Contribution concerning Paracentesis.

Paracentesis may be defined as the act of puncturing a part, or organ, for the removal of fluid matter.

Although the practical value of paracentesis in the treatment of effusions, is generally admitted by medical writers, there is still wanting an uniformity of opinion as to the conditions under which the operation should be performed, and the results which are to be expected from it. Though practised occasionally for many centuries, it was yet looked upon as a dangerous operation, and one not to be employed, except as a "dernier ressort," and this view would appear to be held by some eminent members of the profession, at the present day.

With a view of looking up the whole subject, having been struck by the confident assertions of Trousseau and Bowditch, I am induced to give the estimation I have formed, of its value - having now performed the operation 143 times, and in so doing shall consider the history of the subject, showing how the
pendulum of opinion has swung in both
directions; enumerate and discuss the
cases which have come under my own
care; and give conclusions that arrived
at concerning its diagnostic, palliative
and curative value in peritoneal and
pleural effusions.

Trousseau in France, and Bovaldich in
America have not taken a gloomy view of
thoracentesis, and have urged physicians
to resort to it; much more generally than
it had formerly been thought right to do.

Both of these physicians base their support
of a more general practice of paracentesis
upon the entire absence of any danger in
the operation. Bovaldich goes so far as to say
there is no more danger in paracentesis
"than in vaccination or resection."

Being abashed by these assertions, and
supported by the teaching of Sir Thomas
Granger Stewart, both as a student of
medicine, and while acting as his
Resident Physician in the Royal Infirmary
Edinburgh, the following enquiry was
instituted, and if my study of the subject
has led me to adopt views of an extreme nature, I trust, nevertheless, that the arguments I shall bring forward, in support of my opinion, may be deemed not unworthy of serious consideration.

The method of removing effusions, which, in my opinion, gives the best results, is that of aspiration, and I have invariably used Polk's bottle aspirator.

In advocating the use of the aspirator, as compared with the trocar and cannula method, one should bear in mind that with the latter there is danger of the re-introduction of air into the thoracic cavity, of the production of fistulous orifices, and the too rapid, and therefore dangerous evacuation of the fluid. Moreover, there are cases where the trocar and cannula are not effective although the quantity effused be considerable — where indeed the fluid cannot flow out, although the cannula be pushed in actual contact with it. The explanation of this is now understood. The fluid is kept in the pleural sac by a negative pressure of from 4 to 5
inches of water (Torricelli) 6 millimeters mercury (Donders) 5 millimeters mercury (M. Jost) exercised by the lung in its elastic contraction, and by the passive tension of the arched diaphragm. The fluid has no tendency to flow out, and this suctional pulmonary force must be antagonised by an external suctional force—that of aspiration—before the fluid can be withdrawn.

The invention can best be appreciated from the standpoint reached by modern investigations of the physics of the living mechanism of the chest. The principle of applying suctional force in effusions is in imitation of nature's methods in connection with respiration. Most of the dangers connected with aspiration, are caused by not taking into consideration the adjustment of lung tension with thoracic resilience, and consequently by using too great negative force, and withdrawing the fluid too rapidly.

Pneumocentesis by aspiration with greater or less force as may be necessary, is now
placed upon a scientific basis. Bowditch had
(email Vol. 11, 1879) in 1879, operated 387 times
upon 246 patients without any unpleasant
result.

The distinctive points claimed by Pierafoy
for his ingenious aspirator, introduced in
1869, are, that the needles are very fine, even
one half of a millimeter in diameter; that
the barrel of the exhausting pump is of
glass; that there is a pre-existing vacuum;
that we are not compelled to jar the side of
the patient by the process of pumping and
moreover by turning the cock we produce
at once a vacuum in the needle itself, and
know with certainty the moment the fluid
is reached, and can see it flow through the
glass induct in the tubing, even if it be in
drops. We can judge of the nature of the
fluid, whether it be serum, pus or blood.
The minuteness of the needle is a great cause
of safety, because it allows the fluid to flow
so gradually, that the lung has time to
expand slowly. We can, in an instant
stop the flow of the fluid by turning the
stopcock, and, if necessary, by drawing
out the needle.

There is no doubt Dicuafay's instrument was a great advance on any other that had been invented. Its simplicity, its easy application, its safety, have rendered paracentesis a harmless operation, and one of great value in serious effusions. There have been proposed, since Dicuafay showed his instrument in 1869, over fifty other aspirators, modifications in form or dimensions of his apparatus. Of these the most valuable to us is Bollani's bottle aspirator, with which aspiration can be so easily and effectively employed. An India rubber cork accurately fitting a strong bottle is perforated for two tubes, each having a stopcock. One of the tubes fits on the end at the exit in the basin, and the other is adapted to an aspirating syringe, and this is the instrument I have invariably used.

The principle of aspiration is now well established, and the indications for its use are becoming more defined, and more accurate. New applications as a means of diagnosis, as well as of treatment,
daily render it more valuable.

To guard against the dangers shown by modern experience to be sometimes attendant upon the operation of aspirating the pleura, it is now generally admitted that the removal of the contents of the chest should be slow and gradual. Our object should be to remove pressure, and allow nature by absorption to take away the remainder, for positive pressure is an urgent indication for paracentesis. It is therefore of primary importance to properly estimate the quantity present, and thus to limit the intra-thoracic pressure. Large sized cannulae should never be used for fear of too rapid withdrawal of fluid. It has been demonstrated that even with a capillary perforated needle we can exercise more negative pressure than is safe, especially towards the close of the operation, when there supervenes a negative pressure exerted by the fluid remaining in the pleural cavity. It is from these well known facts that we recognise the great value of Toldt's ingenious addition to the aspirator of a manometer of great
simplicity, a kind of barometer or cuvette, which is placed along the tube which withdraws the fluid.

The main indications for the employment of the aspirator would appear to be

1. Where there is non-absorption of the effused fluid.
2. Where there is an excessive accumulation of fluid.
3. Where urgent distressing symptoms are present.

Other indications would appear to be:

- Where the general condition of the patient is such as excludes hope of rallying; i.e. very old, or if he have intervening croupous pneumonia, if the quantity is not large, and is not interfering with organic functions, we can wait. Pyrexia would appear to be a reason for delay.

In instituting an enquiry into the different modes of treatment, that have been, or are at present in use, for the relief of effusions, the attention of the enquirer is at once arrested by the method of treatment known as paracentesis
- or the pricking of a part or organ, and withdrawal of fluid by mechanical means. This plan was recommended, and apparently practised by Hippocrates. It has been revived in modern times, and is at the present day advocated by many physicians. Its supporters claim certain advantages from its use. These may be held as resolving themselves into two main points:

1. Certain beneficial results to be derived.
2. Certain dangers to be obviated

   1. Sudden death.
   2. Conversion of serum into pus.
   3. Collapse and Carcification.
   4. Consumption.
Historical.

Among the ancients, dating back to the time of Hippocrates, it was practised, and was known as the “operative empyema.” Hippocrates used the word ἘΥΠΕΥΜΕΝΑ, signifying an internal collection of pus just above the cavity of the peritoneum, above the diaphragm. Subsequently he speaks of empyema of blood, empyema of serum, empyema of gas, but not of pus, applying the term to the operation, which he employed principally for empyema necessitatis. Subsequently the name empyema was used, as now, to designate a purulent collection in the pleural cavity.

If we may credit the story which has descended from mythological times, the operation for empyema had its origin in an accident. It is related that a certain Phalerens, who was attacked with what was denominated an ulcer on the lungs, was pronounced by all his physicians to have an incurable disease. In his despair he exposed himself in battle so that he might be slain; the enemy’s weapon, however, pierced his side, making an opening through which the pus escaped and he recovered. (Cicero, De Natura Deorum lib. iii. cap. 28).
It is certain that from the most remote periods the chest was opened, when collections of pus had formed. Galen states that the ancients employed actual cautery for that purpose. He reports that Epiphanon de Aide by this means saved the life of Cinesias son of Evagoras (Comm. in Aphor. Hipp. lib. vii.). The details into which Hippocrates and his school entered in regard to the operation show that it was frequently performed in their day. It is remarkable that many of the more important precautions of the operation were observed by Hippocrates. We find from the Aphorisms that the operation was considered the only means of cure (lib. vii. Aph. 44) and that when the precautions were observed, and the fluid was white and of good quality, the patient recovered (ibid. lib. vii. Aph. 27). The principal precautions were not to delay the operation after the existence of pus was recognised, and to draw off the fluid. He further states that if the serious fluid in the cavity of the chest, or pus in empyema, should be drawn off too rapidly, the patient would die impressed with this view that they adopted the operation of perforating...
a rib instead of cutting through the intercostal space, because they could with more ease slip up the spine and regulate the outward flow of the fluid. The later Hippocratics preferred cutting instruments to actual cautery. Hippocrates, if unable to discover the locality of the fluid in the thorax by percussion, applied over the walls of the chest a linen compress which he soaked in earth of Eetria and warm water, and concluded that the collection existed at the points where the earth commenced to dry! When these signs failed, he cut through the most prominent rib, at the base of the chest, and towards the back. He made a large incision through the rib, but only a small one the size of a thumb nail through the tissue beneath the rib. After allowing a small quantity of pus to escape, he introduced a linty undressed flax, with a piece of thread attached to it. This he withdrew twice daily, to allow the pus to flow. At the end of two days he permitted the remaining pus to be discharged, and inserted a rent of linen. To prevent the lung, habituated to the presence of the fluid, from dropping too rapidly, he injected wine and oil.
through a cannula. When the excretailed fluid was thin (serous?) he replaced the tube by a tube of birn, and when it failed to secrete fluid he shortened each day the length of the tube so that the cicatization of the wound extended from the inner end of the orifice (Demonstrations of Medicine)

Galen (A.D. 150) had his syphocan with which to draw out the fluid. Galen and Roger of Panama bored through the sternum. Many of the ancient surgeons such as Euonymus of Gades, Paul of Aegina, Celsus, Tauriger divided the soft parts by cauteries and the knife after laying bare the pleura. Blunt instruments were sometimes used, such as sound. Cleses in his latter years lost confidence in this operation, and it fell into disrepute among the Greeks and the Romans, by whom it seems to have been nearly abandoned. In the Middle Ages the question was discussed whether it was better to open the chest by scalpel or by fire intratracheal pleuritis (Trousseau states that about the sixteenth century the operation of beheading the ribs was revived). About the same time the deensive injections which had been recommended by Galen were again advocated.
especially by Fabrice d'Aquapendente. The operation was unpopular among the greatest surgeons, and but seldom resorted to, except in extreme cases. Notwithstanding the obedience to tradition in those days, some important points were advocated in regard to the propriety of allowing the openings for empyema to remain unclosed for an indefinite period.

Early in the seventeenth century practitioners became less distrustful of puncturing the chest, and were led to believe in the harmlessness of the operation (Trousseau). As a consequence of this tendency, physicians began to study the question of puncturing the chest in hydrothorax.

In 1624, Jerome Goullié asserted that he succeeded more frequently in hydrothorax than in abdominal paracentesis. Twenty years later Zacutus Trétilans asserted that paracentesis was as necessary in cases of serous effusion into the chest as incision in empyema. In 1663 Robin and Dural recommended paracentesis as the best treatment for hydrothorax. Soon after this practice was put in force by Willis. Lower also mentions a case, and
Subsequent authors quoted these cases as an encouragement to the performance of paracentesis of the chest for the removal of serous effusions. Jean de Vigo brought out again the pyrulon. Dr. W. about the year 1665 proposed the use of the brochar as a substitute for the actual cautery in opening the chest.

In 1658 Boullier for the first time took up in a precise manner the subject of the introduction of air into the pleural cavity. He declared there was no danger from it. Bartholin maintained the opposite opinion. The indications for the operation were laid down, but they were necessarily very imperfect. In proportion as attention was directed to the question of the admission of air, the manner of operating was modified. In 1669 Scultetus discussed thoracentesis in his work Anatomantarium Chirurgicium. He made use of a brochar, with a bladder at the external orifice, principally to prevent the introduction of air, as Reynard later used a piece of cat's intestines and a bladder of goldbeater's skin. Scultetus used the pyrulon, a common syringe for injecting the dust, and also the pyrulon for drawing out matter.
as its name implies. This was practically the syphon. Tullius thus describes the operation by incision with his gladiolus salient longus, and by puncture with the canula et acus, both figured in his plates; so also his drainage tubes with directions for shortening them in the cavity heals, and the long tubes, which probably acted by gravitation after the manner of the syphon. Aspiration was made by the mouth, by cups, and by syringes affixed to a canula or catheter (quoted by Pepper).

It is thus evident that more than two hundred years ago aspiration was used to evacuate fluid from the pleural cavity. Trousseau states that "at that period aspiration and suction were used for this purpose—timidly pursued, in accordance with Tullius's example; and that it became afterwards in vogue with the masters of surgical art."

Palpín preferred the brooch to incision for treatment of hydrothorax. In 1707, Tull wrote a book on the art of sucking wounds without using the mouth. Boudelin (1742) rejected the brooch for fear of injuring the lung. That Tullius's practice was continued
is evident from the work of Laurence Heister (1742) who described puncture of the chest with drawings of exhausting syringes for the removal of pus or serum.

In 1765, one hundred years after Domini's use of the Brochar. When perforation by actual cautery was abandoned, Turri, timidly, advocated it, on account of his fear of wounding the lung. He advised the operator to close the cannula with the finger at each inspiration, leaving it open during expiration, so as to prevent the entrance of air. Chopart and Desault opposed the use of the Brochar as a coarse mode of operation, involving the risk of wounding the intercostal artery and lung (Trousseau). Tant Sweeney, at the end of last century questioned the advisability of using the Brochar. Later, in 1796, Benj Bell (Vol V) in cases of paracentesis, used india rubber bottles fitted to the opening for the same purpose, first compressing them and then allowing them to expand by their elasticity. He strongly recommended paracentesis of the pericardium when the amount was so excessive as to cause death.
Saraud de Dieoverbrock (Medie Morb)

RectorisHist 25 plunged a bistoury between the fifth and sixth ribs, and introduced into the wound a silver cannula large enough to fit the orifice, and stopped the cannula with a lint which he withdrew each day. Jean

Tauleritus (Annam Chir. Paris Vol 7 p 20 quoted by Sprengel) recommended several different cannulas, some of silver, some of gold. He also invented syringes, straight and curved, to absorb the pus or make injections into the chest. Tauleritus operated in the sixth intercostal space, he raised a piece of skin, so that it might lap over the orifice after the operation. He used a lint until the eleventh day, when he inserted a cannula. After Tauleritus Sontuweerd (Append ad Sulpit Ann. 1671 quoted by Sprengel) used suction, and contended that it was very successful. Paul Barbetti (Chirurgia lib. 3. Cap 2. Geneva 1688 quoted by Sprengel) considered thoracentesis as indispensable in empyema and hydrothoraxe. He said it was less dangerous than the puncture for ascites. F. Hoffman at the commencement of the eighteenth century (Medicina
consultata, Vol. 7, 1721) gave his full and complete approbation to the operation—performed according to the accepted rules. Dominique Anel (l'art de sucer les plaies sans se servir de la bouche d'un homme, Ann. 1707) was an avowed partisan of the suction of the effused fluids in the chest. He had seen soldiers very successfully suck, with the mouth, wounds of the chest. He invented different syringes and other machines to pump out the effused fluids, some of which were very large, with cannulae whose orifices were very wide and of different shapes.

Lawrence Heister (1742) (Chirurgische Büch 7, Kap 10, p. 89) acknowledged that Anel's syringes were valuable in pumping out the fluids from the middle or lower part of the chest, but not when paracentesis was performed in the higher portions between the second and third ribs. Heister gives (Ibid. p. 72) drawings of exhausting syringes for the removal of pus or serum. C. F. Ludwig published (Diss deval. Pectoris Leipzig 1768) a new apparatus invented by a surgeon named Buecr, to pump out the fluids contained in the chest.
To this machine, which was composed of canulae was adapted a bowl to receive the liquid as it was withdrawn. Ludwig claimed that the especial advantage of this instrument was that it pumped all the fluid out at one time, without the operator being annoyed by any disagreeable odours. Leber (quoted by Sprengel p. 60, Vol. 17) proposed a similar instrument which was easier of application. A. F. Richter demonstrated the ineffectiveness of all these inventions; the blood, he said, would be drawn out with the fluid and by coagula stop up the canula. Valentin (1772) objected to the use of these pumps as applied to chest fluids.

In the latter part of the eighteenth century, there were numerous English and continental writers on the subject of paracentesis. Some of them preferred the trochar to the bistoury, some were in favour of prompt action, and others objected to the operation unless there were threatening symptoms. Valentin urged that the presence, on the chest, of oedema and ecchymosed spots was certain indication of fluid effusion.
During the first twelve years of this century the operation seems to have fallen into disuse. In 1808 Adouard objected to the Hippocratic method, which had been practised for centuries of drawing out small quantities at a time, for fear that the sudden withdrawal of a large quantity would produce a vacuum in the chest. He maintained, and proved, that sudden and complete evacuation had no such result. In 1811 Courisart (maladies du Coeur 1811) drew attention to thoracentesis. In 1812 Larrey discussed its merits. Charles Bell (Treatise of Operative Surgery vol ii p 194) preferred the brochior to the other methods in hydrothorax when he could be positive of the presence of fluid, but he stated that he preferred first to use the bistoury. Operated in the sixth intercostal space, but in empyema he preferred to make the puncture higher. Samuel Cooper (Dictionary of Surgery p 3749) recommended as small an orifice as possible for the evacuation of the serous, but larger and wider ones for pus and blood.

In tracing the history of this important operation, we thus see that it has been
performed from the time of Hippocrates, and that it has been held in different degrees of estimation by the numerous authors who have discussed it—that sometimes it has been popular, and again regarded unfavourably.

Up to the period now reached (1816) great difficulty of accurate diagnosis existed. Errors as to the character of the fluid, when present, and still more as to its existence in the chest, frequently led to unpleasant results. —Laennec's genius so completely cleared up the differential diagnosis of all diseases of the chest, including pleurisy, that men grew less timid. Laennec (Traité d'Insufflation médicale: 1818) himself was a strong advocate of the operation; he advised it in acute pleurisy where dyspnoea, threatening life, supervened, and in chronic cases where other remedies failed. He proposed to apply a piston-capping glass over the wound after the discharge of liquid, and to produce a vacuum in the chest more or less quickly, continuously, and completely according to effects.

As Bowditch (quoted by Pepper) states—"we should be groping in the same dark way"
"and perhaps getting into the chest by caustic" "pastes or the actual cautery, had not therein" "discovered for us auscultation, with all its" "admirable powers of diagnosis of thoracic" "affections."

In 1815, Blondel practised puncture of the chest with a bistoury. Gaudrun performed the same operation in acute pleurisy in 1831, but with only bad results. Townsend (1833) (G.P. Prac. Med., vol. 17, p. 43) acknowledged that the operation had fallen into disuse, as much from uncertainty of diagnosis, as from any experience of its general danger. He gives the result of Thomas Davies' operations—8 out of 10 successful cases in empyema, with 7 fatal cases in pneumothorax with effusion (probably tubercular), and 3 fatal cases in hydrothorax. Davies used a grooved needle to determine the presence of the liquid, its quality, and the thickness of the walls. After the operation his practice was to inject a weak solution of chloride of lime, which he found to have the effect of diminishing the discharge and correcting its character. 

Robert Law (Ibid) pronounced paracentesis
more successful in chronic than in acute pleurisy. Townsend doubted whether the admission of air was hurtful; he quoted Nycten and Spies' experiment, showing that air introduced into healthy pleura was invariably absorbed in a few days.

Dupuytren proposed (1814) the introduction of a small cannula with a very flexible substance at its outer extremity, such as the bladder of some domestic animal, which would allow fluid to escape, and at the same time would oppose the entrance of air into the chest. Becker (1834) published a work in which he investigated the nature of the false membranes in pleurisy, and showed that the access of air did not produce unpleasant results. He reported 2 successful cases out of 3 of operation.

P. Townsend (Gaz. Med. vol. 11, 1838, London) wrote an elaborate paper in 1838 on empyema, in which he applied the principles of physical diagnosis. He cites numerous cases of thoracentesis and speaks of the operation as easy of execution, productive of little pain to the patient, generally followed by
immediate relief, and as having been in numerous instances crowned with complete success. Dr. Law (Proc. vol. iii. 1834) speaks discouragingly of the operation in consequence of the unavoidable admission of air into the inflamed cavity. He considered the operation of tapping the chest more likely to be successful in chronic than in acute pleurisy.

In 1835 Faure (Bulletin de l'Académie de Medicine. 1838, tome ii. p. 62) read his paper on paracentesis before the Academy of Medicine of Paris, which attracted a great deal of attention. Contradictory opinions were given by prominent members as to the value of the operation. The debate was prolonged, and no definite conclusion was reached. Faure, although he had recommended the operation in excessive effusions and in chronic cases, was yet timid, and his advice had not the overwhelming influence it should have had. Becker of Berlin in 1834 wrote his paper on chronic pleurisy, in which he also laid down the principles of diagnosis by means of auscultation and percussion. He
detailed 5 cases which he had operated upon. To Thomas Davies is due the credit of having
in 1835 recommended the use of the exploring
grooved needle to ascertain the nature of the
pleuritic effusions, but Powell claims that
Sir Benjamin Brodie first suggested it. Ruiger first
recommended the use of the hypodermic
syringe for that purpose. Stokes, Dis. of Chest
Dublin, insisted upon the evils attending
paracentesis, among which he mentions
the conversion of serous into purulent effusions.

Watson's lectures on practice delivered in
1836-37 show that he was much interested in
the operation, but his conservatism led him
to put prominently forward the dangers
and evils connected with it. According to
these two prominent English practitioners
only immediately peril to life justified the
operation. Guerin (Essai sur la méthode sans-
Contoune, Paris, 1841) in 1841 applied his
subcutaneous method of operation to
empyema. He drew fluids from the chest by
a suction pump applied to a canula, using
a curved biochar and canula to prevent
injury to the lung.
Keybard in 1837 took up Dupuytren's suggestion, and used goldbeater's skin as a valvular means of excluding air at the mouth of the cannula; this is now known as Keybard's cannula apparatus, and was the one used and highly recommended by Trousseau. Hanski in 1839 invented an apparatus for drawing off air from the chest, working on the principle of aspiration. Bowditch states (quoted by Peper) that while in Paris from 1832 to 1835, he never saw a case of pleurisy in Louis' Choudet's or Audrals' wards where thoracotomy was performed, or even suggested. Medical opinion was either indifferent or in actual opposition at that time. Bowditch relates (Amer. Journal Med. Sciences April 1852) that he saw two cases of effusion in the pleural cavity in 1839, in which he proposed thoracentesis, but the surgeons would not operate; both of these patients died. He was convinced at the time that their lives might have been saved. Schub of Vienna published his work on the influence of Auscultation and Percussion on Practical
Surgery, in which he boldly maintained that paracentesis was a radical cure in cases of chronic thoracic effusion, no matter how originating. This work had a great influence in advancing the popularity of the operation of thoracentesis. Subsequently, Schuh and Skoda, both professors at Vienna, published (Medizinische Jahrbücher der K.K. Oesterreich Staatic, 1841) a monograph on the treatment of pleurises, especially by surgical means, which, as Troussseau acknowledged, has become a classical work in Germany, and occupies a distinguished place in the history of paracentesis of the chest. They admitted that when the effusion is not excessive in quantity, and there are no complications, recovery generally takes place. When the effusion is excessive even, it may in time disappear, but it may prove a matter of months or years. They advised that the operation should be performed when there was no marked improvement for three weeks. These authors refuted the arguments used against the operation, and gave details as to the mode of operating.
The Germans were the first to consider the puncture as a means of radical cure in pleuritic effusions.

Thus we see that up to 1841 these unsettled controversies over the dangers and advantages of the operation were still going on. Bied's results in 1843 proved the possibility of its successful employment, doubled up to that time in England. Traussean's attention was strongly drawn to the necessity of the operation as early as 1832, when he attended a case at the Hotel Dieu that died from excessive pleuritic serous effusion. Louis, from the observation of 150 cases of simple pleurisies that had recovered, had enunciated the law that pleurisy is never the immediate cause of death. This fact, together with Recamier's want of success, had so prejudiced the minds of French practitioners against the operation, that it was loudly condemned in acute cases of effusion, and in all cases of hydrothorax. Having no fears of fatal termination in pleurisy, they naturally saw no necessity for surgical interference. Traussean states that it was not until after
he had seen three patients die from acute pleurisy that he remedied by operation. (Sept. 11, 1843) He did not summon a consultation for fear of being thwarted. It was so successful that he was emboldened to operate without hesitation. After his third operation he read his memoir to the Academy of Medicine in 1843. Trousseau in these memoirs maintained the proposition which extensive observation has now fully sustained, that depression and orthopneic may occur when the effusion is in moderate quantity, and that they may be absent when the effusion is considerable, especially if it has formed slowly. Furthermore, that the signs that constantly indicate the gravity and imminent danger of effusions, and which consequently demand the operation are the displacement of the heart (whence results syncope), displacement of the mediastinum, depression of the spleen and of the liver, acceleration and feebleness of pulse, and an anxious countenance.

The next year (1844) Trousseau read another memoir on the same subject.
He used the trochar with Keyvard's goldbreaker's skin at the orifice. While he was popularising the operation, and laying down the indications which called for its performance, several English observers were turning their attention to the subject (J. med. Gaz., 1847).

The paper by Hughes and Cook (Gent's Hosp. Reports, vol. 7, 1844) showed that they had been operating in Guy's Hospital for four or five years, and with great success, using a simple trochar and cannula of the diameter of one twelfth of an inch. They attributed their success to the small size of the instrument used, which allowed fluid to flow slowly and never permitted air to enter the chest during respiration.

They gave a tabular account of 20 operations — Hamilton Roe (J. Lancet, 1844) at that time was operating successfully with the trochar. Roe's paper was replete with information and with practical suggestions. He tabulated diseases where syncope (one great objection which had been urged against the operation) did not occur even once. He disproved another popular objection that there was great danger of the admission of air into the pleural sac. Owing to the size of his trochar...
a considerable quantity of air entered the pleura during his operations, and in some of them so freely as to produce all the physical signs of pneumothorax, but in none of them did it produce any permanently ill effects. In one instance only was even temporary inconvenience caused. When the fluid was ascultated by the exploring needle to be prevalent, he advised the immediate performance of the operation. In acute cases he recommended a delay of three weeks, as the time for testing nature’s powers of absorbing the fluid. He advised the closing of the orifice after operation. This author gave an account of his 24 cases. He concluded by stating that the operation is not more dangerous than any other which is performed on the human body, and that the evil consequences supposed to attend it are imaginary rather than real, inasmuch as it was only fatal in one out of 24 cases, and does not produce even temporary inconvenience. Thompson in the same year justly condemning the practice of leaving the cannula in the orifice—proceeding he considers as capable of converting a serious
into a prevalent field. In 1848 (Staten Jour. Med. Sciences April 1852) at the request of Bowditch of Boston, Warren operated by the usual method recommended in the works on surgery. Partial relief was obtained, but the amount of suffering undergone by the patient during the operation, and the fact that an aperture was usually left open by this method, decided Bowditch that he would never recommend it unless under very urgent circumstances.

Soon after this Stone operated with the common brochar and camilla, by the advice, in consultation, with Bowditch.

Although suction, as has been shown, was used as far back, probably, as Galen (second century), by Scultetus in 1662, and was in use in 1707, as shown in Anel's work, in 1742 in Keister's work, by Ludwig and Lehren in 1768, again in 1796 (Benj. Bell), yet it had been abandoned and lost sight of, with the exception of Saurmeier's suggestion of its application in the form of a cupping glass over the orifice of puncture, until Green (1841) used it. Pepper (Medical and Physical) 1845 he saw Drouot use repeatedly, operating with.
Reynard's cannula guarded by gold-beaters skin, but never with Guerin's suction apparatus. The French seem to have lost sight of it until 1865, when Guerin, at the French Academy, recalled attention to it, showing how he aspirated liquids instead of allowing them to flow outward after the puncture.

Diculafoy, in Nov. 1869, invented his aspirator, which was based upon the same principles as that used by Guerin (1841). Troussseau's first publication was in 1843, and yet in 1859 there was no general adoption of the operation, nor was there until Diculafoy read his paper.

In 1850 Sir James J. Simpson reduced the large head of the old trochar to the same size as the shaft, so that it should stretch the orifice less, and, as the cannula could then be advanced without spreading, he omitted the split in the end, and published his employment of a long and slender trochar of this kind, with an exhausting syringe attached, as a means of diagnosis in various uterine enlargements, especially in pelvic tumours, and so initiated the idea which Diculafoy afterwards developed. The plan of having the cannula itself pointed,
so as to penetrate independently of the stylet; was first conceived by Ferguson of London, who in 1853 devised a penlike tubular needle for injection of perchloride of iron, in the treatment of naevi and aneurism. In 1855 Dr. Alexander Wood of Edinburgh adapted this to the subcutaneous injection of morphia, and a modification of the same instrument is now in universal use. Dr. J. Roberts of Manchester (Med. Times Gaz. 1873 11 p. 486) first made use of syphon power in tapping abdominal collections of fluids. Stalwarton Regio (Edin. med. journal 1866 51 p. 1076) makes an eloquent appeal for the use of the aspirator, and since then much has been written on the subject by Brady of New York, Bowditch of Boston, Dr. Wyman, Dr. W. J. Fairdene and others.

Sir Thomas Grainger Stewart in an article (Med. Times Gaz. Jan. 31, 1874) brings forward very clear proof of the advisability of interfering surgically in cases of serous effusions. His interesting case is replete with information on the subject, as his patient was relieved of 12, 120 ounces of fluid, with the most brilliant results.
Some points in the Pathology of Effusions.

The reason why fluid re-accumulates so frequently would appear to be a diminution in the natural absorbing power of the membrane owing to its having been so long unduly stretched by its contents.

Dropsy, like many other morbid conditions, is merely an exaggeration of a state of health. There is a continual outpour of lymph from the capillaries, some of which is employed in nutrition, some absorbed by the lymphatics, and some by the veins. In health, this fluid is carried off as fast as esculated, so that there is no accumulation; if there be accumulation it constitutes dropsy. This may be produced either by an increase of outpour, or a diminution of removal, and the diminution of removal may be hypothetically attributed either to the veins or the lymphatics.

Average Constituents of Dropsy Liquids in 100 Parts.

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Heart Disease</td>
<td>1.832</td>
<td>0.784</td>
<td>1.014</td>
<td>2.63</td>
</tr>
<tr>
<td>Lung</td>
<td>1.351</td>
<td>0.826</td>
<td>1.017</td>
<td>3.13</td>
</tr>
<tr>
<td>Liver</td>
<td>1.012</td>
<td>2.25</td>
<td>0.842</td>
<td></td>
</tr>
<tr>
<td>Kidney</td>
<td>1.012</td>
<td>1.36</td>
<td>0.875</td>
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</tbody>
</table>
It is interesting to note the uniformity of the mineral salts—almost the same proportion in which they exist in the blood. This looks as if they owed their exit to some unvarying physical law like osmosis or dialysis, and to this we may fairly attribute the presence of these crystalloids in serous effusions. No such uniformity holds with the albumen, which varies much. When cardiac the albumen is greater by about one half than when renal. Pleural and peritoneal effusions are always highly albuminose, sometimes the pleural more than the peritoneal sometimes the reverse. When due to heart disease the effusions contain more albumen than when due to kidney disease. The peritoneal effusions of cirrhosis of the liver would appear to occupy an intermediate place in this respect. The smaller amount of albumen under kidney disease corresponds with the reduction of this substance in the blood in the same condition. The saline ingredients are probably the simple results of dialysis. The albumen, as a colloid body, cannot be reverse by this means but obtains
its passage by pressure, by secretion, or by both together.

For the purposes of practical medicine - serous effusions may be described as having two modes of origin.

1. Increased blood pressure

2. Alterations in the blood itself

and these two conditions often occur together.

Luschka showed (Pr. Foreign Med. Chir. Rev. Vol. II, 1853 p. 346) that the pulmonary pleura is supplied by the vagus, at the root of the lung, and that the parietal pleura is supplied by the intercostal branches of the spinal cord, and branches of the sympathetic. The parietal pleura is very open and has no basement membrane, and the lack of absorption may be due to want of tone of intercostal muscles. If this be so, the method of treatment by interrupted current, advocated by Ernie Ross should be successful in causing absorption of serous effusions. But I have tried this method and found absorption did not take place.

had previously been lowered, he could produce
directly, pleuritis with purulent deposit,
by the simple division of the Great Sympathetic
Nerve. In order to ensure the success of this
experiment, it is absolutely necessary that
the condition of the animal's health should
be previously lowered. Hence, he contends
empyemas may occur without oedema
from without.
Some Clinical Features attending Effusions.

Syncope. Bartlis has pointed out syncope is more likely to occur in left sided pleurisies, probably due to a twisting of vena cava inferior as it passes through the quadrilateral foramen of the diaphragm, consequent upon the heart being pushed over to the right side by the effusion (Dict med journ. 1877 II 755). In large effusions this danger will be increased by the longer continuance of the effusion, and we ought to operate earlier in left sided pleurisies, than when the effusion is on the opposite side. On this very ground. The gradual withdrawal of the fluid, which may be accomplished by the aspirator, diminishes the risk of syncope, whereas if the fluid press to the heart be suddenly removed by the rapid withdrawal of the fluid, the danger will be increased.

Albuminous Expectoration. Several fatal results have been met with on the Continent from what is, by the French physicians termed “albuminous expectoration”, and
which, as stated by Taeuber (Sieusseni's Golo, vol. IV. p. 672) is obviously identical with acute oedema of the lung. If this condition is due, as suggested by Dr. Johnson (Brit. med. Jour. Oct. 1873, p. 479) to blood clots in the pulmonary capillaries, caused by coagulation in the pulmonary veins, it is rather an argument in favour of operating at an early period of the disease. The attacks usually supervene during paracentesis, more rarely afterwards. They lasted usually only a short time. The quantity of fluid varies in these cases, and is, both like that of acute bronchitis, containing much mucin and but little albumen. The physical signs are those of congestion of the lungs. Dr. Samuel West (Brit. med. Jour. 1876, p. 974) states it is not to be connected with the use of the aspirator, for some cases have occurred where the fluid was removed by the siphon only. The result was rarely fatal, and among the fatal cases some complication besides the effusion was generally found. The condition seems less common than it used to be thirty years ago, probably because of the earlier performance of paracentesis.
Albuninuous expectoration has occurred in several of the writer's cases, notably in Case 7, but the attacks were never serious, nor did they last long.

True explanations are given of this phenomenon.

1. Perforation of the lung during paracentesis and the discharge of the pleural effusion through the lung; but the difference of the chemical character of the two fluids showed that this explanation could not be correct.

2. The absorption of effusion by the lung.

3. Oedema of the lung; and this last would appear to be the only satisfactory theory.

Dyspnoea. This is, in my experience, the most common symptom attending effusion. In all cases where the effusion is large, and where the dyspnoea is at all urgent, it is better to operate at once. There is, in my opinion, more danger in delay than in operating. Whether the case be one of acute or chronic pleurisy, better results may be obtained by paracentesis than could be expected from any other treatment. It is my practice to operate at once in all cases where the chest is two parts filled with fluid, without
waiting for urgent dyspnea to set in. But if the chest be only half full, I usually wait for a few days to give a chance to ordinary treatment. If, however, in the course of a few days there be no diminution in the amount of effusion, think it better to operate than to wait. Recovery is in this way more speedily expedited.

Cough: Frentzel remarks cough is probably set up by the ready admission of air into the lung which has been compressed, or it may be from irritation of the surface of the lung by the cannula. The former theory is probably the correct one, for I have known cough to supervene when much fluid was present and the lung could not be reached by the cannula, again, I have felt the end of the cannula rest against the pulmonary pleura, with no cough ensuing.
Cases in which Aspirator can be used.

Dyce, J. A Treatise on the Pneumatic Aspiration of Morbid Fluids. Smith, Elder 1875, quotes the following list of cases in which the aspirator can be used.

Liver
- Hydatid Cysts.
- Abscesses.

Bladder
- Retention of urine.

Stomach
- Diseases of
  - Cases of poisoning.

Syringes
- Cysts.

Head
- Hydro-cephalus.

Spine
- Syrinx Bipida.

Intestine
- Traumatic Hernia.

Heart
- Pericarditis.

Lungs
- Acute and Chronic Effusions.

Knee
- Synovial Cavity.

Penitoneum
- Peritonitis.

Serosa: Peritoneal.

While Dyce (Transactions of International Medical Congress, Philadelphia 1876) quotes the following Hydrothorax.
Enpyema.
Hydropericardium.
Ascites.
Pedunculated deposits in abdomen.
Cysts of Broad Ligament and Adnex.
Intrapelvic and Lumbar abscesses.
Retention of urine with impermeable urethra.
Pituitary syringomyelia.
Strangulated hernia.
Hydrolids and abscesses of liver and kidneys.
Effusions within or without joints.
Hydrocephalus.
Spina Bifida.
The main indications for performing paracentesis may be said to be:

1. Where there is a large effusion accompanied with dangerous symptoms viz., dyspnea, orthopnea, cyanosis, interference with the action of the heart, and threatening syncope.

2. In cases of considerable effusion which after a fair trial do not yield to treatment, and show no signs of becoming absorbed.

3. In all cases in which there is complete filling up of one pleural cavity.

4. In cases of double pleurisy, when the total fluid may be said to occupy a space equal to half the united dimensions of the two pleural cavities.

5. When the fluid is known or suspected to be purulent.

6. When a spontaneous opening has formed towards the upper part of the chest.

7. Where there is a phthisical tendency, or where there is a gradual wearing out of the patient’s strength.
Method of Operating.

1. See the needle is sterile, previous and clean, and the syringe in order before using it.
2. Push the needle straight on, in one direction only.
3. Hold the needle steady during aspiration.
4. Aspiration must cease at once when blood comes in any quantity, especially in abscesses.
5. Keep up the vacuum during the withdrawal of the needle. Let some of the morbid fluid be left in its track.
6. If the needle become choked, use the probe.
7. Cleanse after use.

Before operating the integument should be rendered thoroughly aseptic, for fear of carrying organisms in with needle; and before introducing this latter, I find it to be a good plan to freeze the part with, say, Ethyl Chloride in order to avoid shock. Cocain does not appear to give such good results as freezing.

In introducing the brochare should be prevented risk of haemorrhage from
wound of intercostal artery, by avoiding, as much as possible the lower margin of the rib in the intercostal space which is selected for the puncture.

Having decided to operate, there are three points to consider:

1. What instrument to use
2. Where the puncture should be made.
3. What amount of fluid to remove.

Instrument: There are in use Forthrey's tubes, Hyman's syringe as recommended by Bowditch, Diinato's aspirator, and the bottle aspirator introduced about the same time by Rasmussen of Copenhagen and Castiaux of Paris, and Potain's aspirator. I prefer the last named instrument; it is easier for the operator, and I think, safer for the patient. The trochar should be of small size, so as to make as small a wound in the chest wall as possible, and to obviate the risk of suppuration along its track, which a larger trochar might cause.

The place I have selected for puncture, has usually been that recommended by Bowditch, e.g. for thorax, in a perpendicular
line with the angle of the scapula, in the eighth or ninth interspace, and an inch and a half above a horizontal line drawn through the lowest point at which the respiratory murmur is distinctly heard on the opposite side. But have not observed this rigidly. It is generally agreed theulothorax should never be used below the tenth rib on the left side, and the ninth on the right, for fear of wounding the diaphragm. For the abdomen, have usually chosen mid-line between pubis and umbilicus to avoid wounding Superficial Epigastric or Superficial Circumflex Hilar arteries.

Amongst endeavour to take away as much fluid from the chest as possible during the operation, provided the patient experiences no unfavourable symptoms. If there be much pain complained of, or very distressing cough, or if patient fall sick or faint, I suspend the operation, and may here remark this has only occurred to me once (vide Case 7 8th Jan 1894).
During the operation the patient may be recumbent, semi-recumbent, or sitting up in bed, and one should always watch the pulse, and administer a stimulant if necessary. If there be a sudden stoppage to the flow of fluid before the effusion is exhausted, it may possibly arise from plugging of the cannula by a fibrinous clot. This has happened to me many times, but it may usually be removed by inserting the probe which is provided for that purpose. As soon as the operation is over and the brochar withdrawn, a little dressing of lint and plaster, or a thin film of cotton wool and collodion, or even a little ordinary strapping is all that is required for the puncture. The plan of placing a small icebag to the seat of puncture, may be followed with advantage, so as to obviate the fear of inflammation being set up along the track of the brochar.
Argument.

In advocating the practice of paracentesis for the evacuation of pleural and peritoneal effusions, that do not yield to ordinary methods of treatment, one cannot but be struck by the diversity of opinion held by some of the most eminent members of the profession, some loudly praising its diagnostic, palliative, and curative value, while others as emphatically decry its virtues. Thus while the most eminent members of the profession cannot agree as to its value, I claim to rank myself under the banner of those who advocate its use, and this I do, after a considerable experience of the practice of paracentesis, for a young practitioner, having performed the operation 143 times. I have studied the subject, and am convinced it has more merits than its detractors will allow, while more than one half the dangers attributed to its use, may be obviated by ordinary care on the part of the practitioner.

Goodhart in an article (Lancet 1878 7:246)
contends that better results are obtained by means of Southey's tubes, that there is less risk of shock, and that the major operation of aspiration is apt to cause peritonitis. Now my experience tends to show that equally good results are to be obtained by the use of the aspirator. In no case in which operated upon I experience shock, and as a proof of that ordinary precautions avoid the risk of peritonitis, I would quote Case No. 7, where the patient was aspirated 79 times, with the removal of 4933 ounces of fluid from the peritoneum and pleurae, and on autopsy no trace could be found in peritoneum or pleurae, where punctures had been made.

Robert J. Mill's Times Gaz. p. 34-63 advocates the use of capillary tubes, claiming over the major operation.

1. The use of much smaller instruments.
2. The contents of eutrophic cavities, cysts, and abscesses are removed with greater completeness.
3. The prevention of the admission of air, in tapping the clots and chronic abscesses.
4. The gradual withdrawal of the fluid.
5. The operation is rendered less formidable.
6. The lesser risk of haemorrhage and sepsis.

To deal with these arguments seriouness:

1. My experience tends to show that capillary tubes are apt to become blocked, if the fluid to be evacuated be thick, or contain flakes of lymph, besides, the use of capillary tubes—necessitates a longer attendance, or at least a return visit, on the part of the practitioner, a consideration for a busy physician.

2. It to my mind, an open question, and I—content that the bottle aspirator at present in use, is equally effective in this respect.

3. As regards the admission of air, this is—provided against in the bottle aspirator, but may be inadvertently done by the—attending physician. I have known air to be admitted to pleural cavity on three—separate occasions, with no evil consequences, either immediate or remiss, resulting.

4. The fluid may be withdrawn by the aspirator as slowly or as rapidly as one wishes, and if urgent symptoms, as dyspnoea, are present the aspirator is of more use in evacuating the cavity more rapidly; and thereby relieving the patient's urgent symptoms.
5. This is, in my opinion, an open question, especially if due antiseptic precautions are observed, which are necessary whether capillary tubes or aspirator be employed. Again, the use of Ether Chloride prevents the employment of the aspirator being practicable. When using the capillary tubes, a longer time is necessary to complete the operation, and a longer attendance on the part of the medical man.

6. In using the aspirator haemorrhage and sepsis may be avoided by ordinary precautions on the part of the practitioner, as witness, Case 7, already quoted.

So they (Santé, 1878, VII. p. 176) advocates the employment of his capillary tubes, and, quoting a number of cases where they were employed in St. Bartholomew's Hospital, ascertained the average rate of flow to be from 10 to 20 ounces per hour. He claims for this method:

1. Pressure is slowly relieved.

2. Syncope is thereby avoided.

3. There is no necessity for swathing patient in bandages, a consideration in hot weather.

4. In using the aspirator pressure can be
relieved at any rate, by regulating the amount of flow, by means of the stopcock.

2. Syncope is, in my opinion, more or less of a longbear, brought forward by those who do not use the aspirator. By the judicious use of this instrument, and observing only ordinary precautions, it should never result. Have performed the operation many times and have never seen, even the appearance of syncope.

3. If operating on the thorax simple dressing is all that is necessary for closing up the orifice, and if on abdomen, dressing and a binder is all that is required.

Frick (Daneel 1876. II. p. 501.) records an interesting case, where a nurse in the Leicester Borough Asylum was aspirated twice in two days, and a very large quantity of fluid withdrawn from the intestines, causing relief of tension of abdomen, enabling bowels which had previously been confined to act, and being followed by no inflammatory action.

Barnes (Brit. med. jour. 1877 II. p. 765.) records the removal of 150 ounces of pus from the chest, with recovery. Andrew Clark (Daneel 1870 I. p. 7) records a case of empyema cured by phrenectomy.
Jenkins (Soc med 1876, p. 860) records a case of empyema where 144 ounces of pus were withdrawn at one sitting, then 340 ounces, then 250 ounces, with complete cure. In Medical Times and Gazette 1869, p. 615 there is a record of a large effusion into the pericardial cavity of the heart, point being removed, and also a case of hydatid cyst of liver cured by paracentesis. And might quote many more cases.

Bensel (New York Medical Journal 1891, p. 689) on "Aspiration from the patient's standpoint," records that in aspirations conducted upon himself, cocaine caused anaesthesia of the skin, but not of pleura, as he distinctly experienced pain on trochar puncturing pleura, but not on Case 7, with Ether Chloride, complained of pain in neither.

Dr. Regnle (Edin. Med. Jour. 1866, p. 1073) relates a case where 254 ounces were removed, and patient was dismissed cured, after subsequent treatment by counter-irritation and diuretics. In another case of a man of over 70 years of age, with heart disease and ulcerous aneurysms, vessels, 50 ounces were withdrawn, and he was dismissed, cured. But, he says, note the
limited amount of fluid removed. While an equal or greater amount remained, generally speaking, he advocates its use strongly, and says it does not matter much if air does enter. He has seen a patient nearly faint from too rapid withdrawal at a sitting, and, he says, think what fainting means in such a case. In another case, a child, 4 years of age, he removed 1320's a cure resulting. His experience tends to show it is more often successful in children than in adults. He quotes other cases in children of 3, and 5 years of age, and says the operation may often be indicated on account of the difficulty often experienced in giving drugs to children. In empyema cases he states it should be performed early, before pus begins burrowing.

When it should be done cannot be obtained from statistics, but this method of enquiry gives a reply as to:

- How quickly influence recovery
- How quantity after thoracentesis.

"The latter part of the enquiry may be answered in a single word; Where the effusion has been very large, when it has been excessive..."
recovery has often occurred, but the success of
the operation is greatest in cases not marked
"by languoriness, but by the comparative smallness"
of the effusion. As regards the quality of the
"fluid, Hippocrates attached a distinct"
"prognostic value to the nature of the pus",
"and this has been generally done from his"
"day down to the present time."

Sir Thomas Graham Stewart (by whose
courtesy I am enabled to quote my cases)
records a most interesting case (Med. Times
Gaz. Jan. 31, 1874) where 12120 fluid ounces
were removed from abdomen by aspiration,
resulting in patient being dismissed cured.
In connection with this case, the following
extract taken from Grains Dictionary of
Medicine, New Edition, vol 1 p 24 is interesting.
"When due to cirrhosis of liver signal benefit"
"results from paracentesis Rarely does the"
"operation give rise to any ill effects, and it is"
"frequently found that remedies will act much"
"more efficiently after the removal of the pressure"
"caused by the fluid, than they did previously."
Repeated paracentesis has often led to a completi
"cure, while in others life has been greatly"
prolonged, and much comfort afforded.

As regards cases which have come under my own care: Case I was aspirated 79 times, and 4933 ounces of serous fluid removed. I am convinced patient was only kept alive for so long, by aspirating, to relieve her urgent symptoms. The depression and sense of suffocation were painful to witness, and after each sitting, the patient immediately experienced great relief.

In Case II great benefit resulted from aspiration during the time the patient was under observation, and the same remarks apply to Case III, but in neither case would the patient stay, to enable one to estimate future value of relief afforded.

In Case IV permanent cure appeared to result, as I saw patient subsequently to his discharge from dispensary, when he informed me he was quite well.

In Case V a fatal result ensued from heart failure, and occlusion of Coronary Artery.

In Case VI, mania prevented the use of remedies, and a fatal result ensued, as was also the case with No. VII.

Case VIII was complicated with aneurism,
and aspiration gave much temporary relief.

Case IX shows a complete cure resulting after aspiration, as also does Case X.

Case XI shows a fatal result due to malignant disease of pleura, as also does Case XII.

Case XIII, an acute one, shows a rapid recovery and cure, after use of aspirator.

Case XIV shows a fatal result from nephritis.

Case XV left infirmary against advice, and I am unable to give the subsequent history of this patient.

Case XVI shows great improvement attending upon paracentesis.

These results may, at first sight, appear to be very encouraging. I have enumerated my cases impartially, and can confidently state patients' lives were made bearable, by relieving urgent symptoms. While amongst the cases where cure did not ensue, we find occlusion of Coronary Artery, aneurysm, mania, and two cases of malignant disease of pleura, militating against one's efforts.

Cases IX, X, and XIII would appear to show the value of avoiding delay, and in all of
these, immediate relief of symptoms ensued, with no return. As regards the question of delay, my rule has been, to give ordinary methods of treatment a short trial. When, if no benefit resulted, and none of the reasons for delay, enumerated on page 8, were present, to interfere surgically. One should interfere early, for even though the quantity of fluid should remain unaltered, the probability that the lung will quickly expand and regain its function after paracentesis, will become less and less in proportion to the length of time during which it has been compressed, for the layers of lymph that bind it down will have been allowed to become fibrous, and to contract.

While I do not intend, for one moment, to contend paracentesis will cure all cases in which one feels one's self called upon to use it, still in hopeless cases it affords almost immediate relief of urgent symptoms and renders the patient's life bearable, if only for a time; while, if one could but choose one's cases,
Shave no doubt such an one could bring out statistics showing it to be almost infallible as a curative method of procedure. Shave impartially quoted all the cases in which I have used it, and am satisfied of its—in some cases, temporary value, while in others, and especially if acute and unaccompanied by complications, it possesses undoubted value as a curative agent. It will be noticed shave obtained the best results in acute pleuritic cases, and, as a means of permanent relief, it is in these cases, that its early use is indicated.

In bringing this thesis to a close, I trust shave sufficiently shown the high value I place on paracenteses in the treatment of effusions, and that my confidence is based upon good grounds, and should like to think of medical men, that Rasmussen says of those in Copenhagen—that every medical practitioner possesses his aspirator apparatus, and makes use of it in suitable cases. Treatment thus leaves nothing to be desired, the little,cite, et procede unsufficiently fulfilled by it.
Case No. 1. (Cardiac)

Mary Nelson, a married woman, aged 31, was admitted to Ward 25, Royal Infirmary, Edinburgh, on 19th Nov. 1894, complaining of pain in the region of the heart, swelling of limbs, dyspnoea, coughing, and spitting of blood. This has lasted for some eight months. Family history revealed nothing important. The had borne two children, and had had three miscarriages. She had Scarlet Fever three years ago, and a severe attack of pleurosy, one year prior to admission. There was no history of rheumatism or chorea. On admission, there was marked oedema of abdomen, legs, and arms; in fact, her condition might be described as "waterlogged.

Respiratory System: Lips cyanosed, gums and fauces congested, tongue raw looking, fissured and indented by teeth, thirst very marked; abdomen swollen, liver enlarged.

Haemopoietic System: Spleen enlarged.

Circulatory System: Cardiac pain, palpitation, and dyspnoea very marked; epigastric pulse present; cardiac impulse in 6th interspace, an inch external to nipple, very diffuse. Superior border of cardiac dullness at upper border of third rib, right border
half an inch external to right border of sternum, left border at anterior margin of left scapula. Rough systolic murmur in mitral area pulmonary second sound reduplicated.

Respiratory System. Breathing 40 per minute, regular. Has severe cough, sputum being tinged with blood. Local secretions diminished on left side anteriorly. Percussion NOT impaired in left infra-clavicular region, and over both bases posteriorly. Auscultation reveals coarse crepitations all over lungs.

Integumentary System shows marked edema of arms, legs and abdomen.

Urinary System. Quantity 1600cc. Colour dark brownish yellow. Specific Gravity 1025. Serum albumen present 6/7 g per lit (2734 g per oz); amorphous urates and epithelial cells also present.

Reproductive System. Amnorrhoea since last March.

Treatment. Patient was given absolute rest in bed, limbs and abdomen were bandaged, and intravenous strophanthus M. exhibited thrice daily. On the day following
admission, dyspnoea was excessive, and the
complained of a choking sensation.
Aspiration was performed, and 500 c.c. of fluid
were removed from left pleura. This gave
relief. Following day similar symptoms
were present, and 490 c.c. of fluid were removed
from abdomen by means of Soutter's tubes.
From this date, to 29 June 1895—when a fatal result
occurred—patient was aspirated 79 times, each
aspiration being necessitated by severe dyspnoea,
accompanied by a sense of choking. She gradually
improved in heart and spirits, and on March
20th, 1895, was allowed out of bed for the first time
since admission, on 19 Nov. 1894. This end was
undoubtedly brought about by repeated
aspirations, while the heart's tone was improved
by freshly prepared solution of Dihydrocnathus,
which Professor Fraser kindly supplied for patient's
use. On April 8th and 21st she had attacks of syncope
but recovered on the exhibition of thin liniment,
and on May 5th she was allowed out of balcony
of ward. Early on the morning of June 27th she had
an attack of vomiting and collapse, with
severe cardiac pain. It would appear
vomiting was induced by patient having
entered a large quantity of strawberries, which had
unadvertedly been left at her bedside. Her
strength gradually failed, and she died on
June 29th at 2 a.m.

Autopsy on July 1st showed the heart to be greatly
dilated in all its chambers, with antemortem
clots in right auricle and ventricle. The aortic,
pulmonary and tricuspid valves were healthy.
The mitral valve showed sclerosis (right) and
also incompetence, with vegetations on the
auricular side of the cusps. Alder's nodules were
found in the ilioaves, spleen and kidneys. The
liver showed great venous congestion. The
brain and other organs were healthy. There
was practically no fluid in the pleural sacs,
and about two pints, only, in the abdomen.
The peritoneum and pleurae were healthy,
skewing no adhesions, in spite of the large
number of aspirations. Neither peritoneum
nor pleurae could traces be found. There punctures
had been made in aspirating. Of aspirations
379 fluid removed = 4933030. I appended charts of
this most interesting case, in order to show dates
of aspirations, and that the progress of the
case may be noted.
TEMPERATURE FAHRENHEIT'S SCALE.

TEMPERATURE CENTIGRADE SCALE.

Name: Mary Allen
Age: 31
Disease: Cardiac
Result: 360°F

1894
19
20
21
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31

Left Pleura aspirated 500°F
Sucker's tubes abdomen 490°F

Left Pleura aspirated 430°F

Right Pleura aspirated 280°F
Sucker's tubes right leg 84°F

Left Pleura aspirated 360°F

Pulse 8
Resp 8
Syst. Gr.
Alkaline
Indigo
Chloride
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<th>Pulse</th>
<th>Resp.</th>
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**TEMPERATURE FAHRENHEIT'S SCALE.**

**TEMPERATURE CENTIGRade SCALE.**

**Abdomen aspirated**

136 10%

210 20%

40 30%

45 30%

25 30%
TEMPERATURE FAHRENHEIT'S SCALE.

Abdomen aspirated
300 cc. Bloodstained
Lift Plura "
30 "

Abdomen aspirated 860 cc. Bloodstained

12:30 am
Abdomen aspirated 4 am 102 o F
Lift Plura "
Right "
102 o F

Abdomen aspirated. 62 o F
Lift Plura "
Right "
24 of.

Abdomen aspirated. 100 o F
Lift Plura aspirated 24 of.
Right Plura "
15 "

Abdomen aspirated 93 "
<table>
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<tr>
<th>Day of Dis</th>
<th>Abdomen</th>
<th>Reaction</th>
<th>Chlorides</th>
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<th>Pulse m</th>
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<th>Temp.</th>
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**Disease**

- Right Pleura

**Result**

- Abdomen aspirated
- Abdomen
- Abdomen
- Abdomen
- Abdomen
<table>
<thead>
<tr>
<th>Date</th>
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<th>Blood</th>
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**Temperature Fahrenheit Scale:**
- Abdomen aspirated: 46°F

**Temperature Centigrade Scale:**
- Abdomen: 41°C
Case No. 2 (Cardiac)

John Gooldyke, a robust young man of 26 years of age, was admitted to Ward 22, Royal Infirmary, complaining of breathlessness, palpitation, dizziness and fainting. He has had three attacks of rheumatism, and symptoms have developed since the last attack. Paralysis of right arm and leg three months prior to admission, but has now recovered from this.

Alimentary System: Appetite meal reduces dyspnea.

Circulatory System: Diffuse apex beat, which is below and external to left nipple. Auscultation reveals mitral systolic and presystolic murmurs, aortic systolic, and accentuated pulmonary second sound.

Respiratory System: Breathing 36 per minute; dyspnea; cough, and opium sometimes tinged with blood. Percussion reveals dulness up to one inch above inferior angle of left scapula.

Urinary System: Specific gravity 1020, contains serum albumen and blood.

Treatment: Dulness not clearing up under ordinary treatment; he was aspirated and 10 oz. of fluid removed from left pleura, relieving urgent symptoms. He continued to improve, but left Infirmary against advice.
Jane Compland, aged 42, a stout, florid woman, was admitted to Ward 25, R.I. E., complaining of swelling of legs, breathlessness, and pain in chest which had lasted about two years.

_**Alimentary System**_ shows discomfort after meals.

_**Circulatory System**_ pain (worst at night), shooting up towards left shoulder. Dyspnoea is worst on making any exertion. Auscultation reveals a systolic murmur in all the areas.

_**Respiratory System**_ dullness on percussion of both bases, and moist rales on auscultation.

_**Integumentary System**_ shows oedema and obesity.

_**Urinary System**_ pain on micturition.

**Treatment.** A hypodermic syringe was introduced and clear fluid obtained. The left pleura was aspirated and 31 ozs. of fluid removed. The right pleura gradually cleared up, and patient was discharged, much relieved.
Case No. 4. (Cardiac).

Robert Dundas, a coachman, aged 47, was admitted to Ward 22, R.I.E. complaining of swelling of legs, and breathlessness, which has lasted seven months. There would appear to be a rheumatic tendency from family history.

Circulatory System: Baccordial pain, palpitation, faintness and dyspnoea. Epigastric pulsation is present. Apex beat is displaced outwards, and there is irregularity of action. A double murmur is heard in mitral and aortic areas, and there is marked accentuation of pulmonary second sound.

Respiratory System: Dyspnoea at bases of both lungs; severe cough; auscultation reveals moist rales and rhonchi.

Integumentary System:Shows oedema.

Nervous System: Patient suffers from insomnia.

Treatment: Ordinary treatment not relieving patient's symptoms, he was aspirated and 450ccs of fluid were removed from the right pleura. He improved, and was shortly afterwards discharged.
Case No. 5 (Cardiac).

Robert Ramsay, a butcher, aged 45 years, was admitted to Ward 22, B.S.E., complaining of dropsy and breathlessness. There is a history of alcohol here, and patient attributes his condition to a soaking he got in the rain, a few weeks since. He was very dropsical on admission, especially in legs and periphery.

Alimentary System. Complains of all the symptoms of dyspepsia, with great thirst. There is dulness on percussion of abdomen except in a small area around umbilicus.

Circulatory System. Head palpitations, inspiratory and expiratory bulging. The heart is enlarged and displaced to the left. Auscultation reveals an apical systolic and diastolic murmur in mitral area and a rough diastolic—systolic murmur in aortic area.

Respiratory System. Cough; much phlegm sometimes tinged with blood; dulness on percussion of bases of lungs. Riesch's rales can be heard all over the chest.

Integumentary System. Marked anaemia of limbs and trunk, deep pitting on pressure.

Urinary System. Diminished excretion; urine contains albumen, sodium urate, calcium oxalate.
Reproductive System. Marked oedema of scrotum and penis, with characteristic dimple in shape of hanger.

Treatment. Diuretics, diaphoretics and dry cupping were tried here without patient experiencing much relief. Five days after admission, his dyspnoea was so excessive that left pleura was aspirated, and 35% of fluid were withdrawn. Patient was aspirated on three other occasions for orthopnoea, and altogether 2060cc of fluid were removed from chest, but patient gradually sank, and died a month after admission.

At autopsy right pleural cavity contained 450cc of fluid, and left one 380cc, pericardium contained about 50cc, and abdomen about 800cc. The aortic valves were incompetent, with marked atheroma of aorta, and almost total occlusion of orifice of right coronary artery.
Case No. 6. (Cardiac).

Eliza Hume, a married woman, age 53, was admitted to Ward 26, I.F.E., complaining of breathlessness, of about six weeks duration. Previous illnesses included rheumatism (lived) and pleurisy. On admission, patient was found to be dyspneic in abdomen and legs.

Alimentary System: Dropsy of abdomen, and enlargement of liver.

Circulatory System: Precardial pain, palpitation and dyspnea. Marked precardial bulging is present, and apex beat is displaced outward. Percussion reveals enlargement of heart, especially to the left side. On auscultation, in mitral and tricuspid areas, a systolic murmur is heard; pulmonary second sound is accentuated, and there is a double murmur in aortic area.

Respiratory System: Cough, sputum, tinged with blood, dulness of bases posteriorly; rhonchi (most marked on left side).

Integumentary System: Thready edema.

Urinary System: Albumen present.

Treatment: Severe dyspnea occurring during the course of treatment by means of diaphoretics and diuretics, patient was
aspirated, a month or so after admission, when 100 oz. of fluid were removed from abdomen, 16 oz. from right pleura, and later, 24 oz. from right leg by means of Touchey's tubes. Two subsequent aspirations of 20 and 56 oz. were performed on the abdomen, patient experiencing great relief each time. She was subsequently removed to Ward D, on account of mania, where she died.
Case No. 7 (Cardiac)

Andrew Paul, a 'street arab,' 14 years of age, was admitted to Ward 22 R.I. E., complaining of pain in the belly want of 'breath, stiffness and swelling in feet and legs, and swelling of belly; duration, one month. No previous illnesses, but there is a history of a kick on left side of abdomen, a month prior to admission, since when his troubles have come on. At the same time he got very weak, owing to being out in rain.

Alimentary System. Appetite and thirst quite, pain in abdomen, and occasional vomiting. Abdomen very prominent, walls tense. Tenderness on pressure in epigastric region. Dulness all over abdomen, except around umbilicus.

Circulatory System. Pain, palpitation, faintness, and dyspnea are all complained of. Marked precordial bulging and epigastric pulsation. Apex beat is displaced 1 finger external to and below left nipple. Auscultation reveals systolic, diastolic and presystolic murmurs in mitral area, systolic in tricuspid and — pulmonary, and a double murmur in aortic area. Pulse obscured by oedema.

Respiratory System. Breathing 45 times
cough with blood stained sputum. Dulness on percussion posteriorly, as high as spines of scapulae. The breath sounds are of an exaggerated pneumonic type, with crepitations most marked in the infra-clavicular regions.

**Integumentary System**

Great oedema of feet, legs, thighs, penis, abdomen, and hands and arms, especially on left side.

**Respiratory System**

Pain and frequency.

Treatment here consisted of cardiac tonics, purgatives, and dry cupping. A week after admission he had a severe attack of dyspnoea when aspiration was performed. Patient experiencing great relief. Between Oct 3rd and Nov 25th aspiration was practised eight times (as below), but he suddenly expired, one day before assistance could be rendered him.

<table>
<thead>
<tr>
<th>Date</th>
<th>Side</th>
<th>Amount (oz)</th>
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<tbody>
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<td>Abdomen</td>
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<tr>
<td>16</td>
<td>Left Pleura</td>
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<td>18</td>
<td>Right</td>
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<td>28</td>
<td>Left Pleura</td>
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<td><strong>473 oz</strong></td>
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</table>
Case No. 8 (Cardiac)

John Blair, aet. 57, was admitted to Ward 22 A. E., complaining of cough, shortness of breath, and epigastric pain. Duration three years, acute attack one week. Father, brother and sister died of heart disease.

Circulatory System. Apex beat displaced outwards and downwards pulsation about size of neck on both sides, with precordial bulging. Marked systolic murmur in pulmonic, and a double one in aortic area. Capillary pulsation present; right pulse is markedly delayed and diminished.

Respiratory System. Severe cough; sputum markedly stained with blood; dulness posteriorly from 7th rib.

Here we have a cardiac case complicated by aneurism. Severe dyspnea called for aspiration on three occasions, 920 grs. being removed, patient experiencing great relief, but he died from heart failure, and on autopsy diagnosis was confirmed.
Case No. 9 (Cardiac)

Janet Tripp, aged 19, was admitted to Ward 25, R.P.E., complaining of pains in joints. Had chorea at 9 years, and rheumatism at 13 years of age.

Circulatory System. Complains of pain, palpitation, and dyspnoea. There is a systolic murmur in mitral and aortic areas, and also friction rub of pericarditis.

Respiratory System. On percussion there is dullness at bases of both lungs, and absence of breath sounds.

This patient was of a markedly rheumatic constitution, and a month after admission was aspirated, on account of increase of dullness at bases accompanied by orthopnoea. Three weeks later she was discharged cured, and has reported herself, from time to time, as being in good health.
Case No. 10. (Pleural).

James Bourke, age 60, was admitted to Ward 22, B.O. E, complaining of pain in the right side of chest. Patient got wet while at his occupation, that of labourer, and after a few days cough and pain came on, accompanied by difficulty of breathing.

Respiratory System. Coughs with much spitting, the act being accompanied by a sharp stabbing pain in the left side. There is bulging of left thoracic wall. Vocal fremitus diminished at left base, where there is dulness, extending as high as spine of scapula. Rhonchi and moist rales on right side.

Treatment. The insertion of a hypodermic syringe revealed the presence of fluid in the left pleura. Aspiration was resorted to, when 600 ozs of fluid were removed. Subsequent treatment was by means of purgatives and diuretics, and patient made a rapid recovery and was discharged cured.
Case No. 11 (Pleural).

(For the records of this case I am indebted to the kindness of Dr. Purves Stewart, my successor, to Sir Thomas Fraser Stewart, Resident Physician.)

Ellen Thompson, a married woman, aged 52, was admitted to Ward 25, R.I.E., complaining of cough and shortness of breath, which had lasted eleven weeks. Her mother died of inflammation of lungs. Eleven weeks before admission she caught cold and had a severe cough. As it did not clear up, she sent for a medical man, who diagnosed inflammation of lungs and bronchitis. She appeared to have been counter-irritated freely prior to admission. On admission she was very breathless and distressed, and could only lie on her left side.

Respiratory System. On admission the whole of the right lung, from apex to base, was absolutely dull on percussion, with a sense of resistance to the fingers. Breath sounds were very indistinct, and vocal fremitus and resonance absent. The liver was displaced downwards, and the heart to the left. She complained of a gnawing pain, about the angle of the scapula.
Treatment. On the night of admission the right pleura was aspirated, and 149 oz. of fluid removed at one sitting, the pulse being well sustained throughout. This greatly relieved the breathing. Between 3rd April and 28th May, the right pleura was aspirated on 8 occasions, 563 oz. of fluid being removed, and on 11th June, on account of fluid accumulating so rapidly, she was transferred to Professor L. A. Mandale's ward, to have pleura drained by the resection of a rib. The patient eventually died of malignant disease of pleura.
Case No. 12 (Pulmonary).

Alexander Watson, a mason, 48 years of age, was admitted to Ward 22 A. I. E. complaining of shortness of breath, and a choking sensation which had lasted five weeks. He was always healthy until present illness came on. Five weeks ago he began to feel unfit for his work, on account of a severe cutting pain in the right side of his chest, accompanied by difficulty of breathing. He is a well-formed man.

Alimentary System. He has experienced difficulty in swallowing since his illness came on. Appetite poor. Thirst excessive. Has vomited occasionally of late. The lower border of the liver is 5 inches below costal margin in the nipple line; the upper border cannot be made out on account of dullness.

Circulatory System. He complains of dyspnoea. Pulsatory and systolic murmurs in internal area. Heart is displaced to left side.

Respiratory System. Respiration 44 per minute; pain in right side on taking a long breath. No cough. There is marked bulging on right side, especially posteriorly. No breath sounds can be distinguished.
on right side. Local resonance and pneumonia are absent.

**Treatment.** On account of orthopnoea, patient was aspirated on five occasions between 30 Oct and 18 Nov. 2600 oz of blood stained fluid being removed from right pleura. On latter date patient died and autopsy revealed cancer of lung and pleura.
Case No. 73. (Pulmonary).

Hugh Montgomery, aged 17, was admitted, complaining of pain in the left side. Duration: three days. Mother died from some chest trouble. He was exposed to rain some week or so ago, and has had a severe cough since then. This has now passed away, but pain has come on in left side.

Respiratory System. Respirations 40 per minute; slight dyspnea; occasional cough; bulging of intercostal spaces, especially on left side; dulness on percussion of left side, with absence of vocal fremitus and resonance.

Treatment. The left pleura was aspirated, and 420 cc of fluid removed. Patient made a rapid recovery and left Hospital within ten days, cured.
Case No 14. (Renal)

John Smart Campbell aged 54, was admitted complaining of pain in abdomen, vomiting, swollen feet, and weakness.

Duration about two months. The patient is an engine fitter, and would appear to be exposed to extremes of heat and cold in his work. Previous illnesses, aague at the age of 16, scarlet fever three years ago.

He noticed he could not draw on his boots on account of swelling of feet, that his urine was scanty and high coloured, and micturition more frequent than usual. Patient shows marked emaciation, general anaemia, puffiness of eyelids, and pearly conjunctiva.

Alimentary System. He has all the symptoms of dyspepsia. The abdomen is distended with fluid, and the liver is enlarged.

Haemopoietic System. Spleen enlarged.

Respiratory System. Dyspnoea customarily on right side. Vocal fremitus diminished on left side, with dulness on percussion as high as 6th rib, and on right side for two inches at base. No breath sounds can be heard below angle of scapula on left side.
Integumentary System shows anaesthesia of legs, acrotion, abdomen and back.

Urinary System. Micturition frequent. Average quantity of urine 240 oz; colour dark amber; reaction acid; copious albumen; urea reduced; urine shows epithelial debris, granular casts, leucocytes, red blood corpuscles, and amorphous urates.

Nervous System. He complains of severe frontal headache, dimness of vision with black spots in the field.

In addition to the ordinary treatment for nephritis, patient required to be aspirated occasionally, mainly on account of orthopaeda, but he eventually died.

Oct 12 Left pleura aspirated 400 oz.
25 " " " 61 "
27 Abdomen " 57 "
Nov 3 " " 70 "
23 Left pleura " 45 "
28 Abdomen " 55 \\
328 oz.
Case No. 15. (Renal).

John Dykes, aged 56, was admitted to the hospital complaining of dyspnoea, which had lasted about two years. His mother died of apoplexy. Being a railway engine driver, he was exposed to the weather, a great deal of illness began insidiously, and he noticed he was passing a great deal of water at frequent intervals, and about three weeks ago severe headaches came on.

Alimentary System. Appetite poor, thirst great, abdomen prominent, distended and dull on percussion.

Respiratory System. Respiration 40 per minute; marked dyspnoea; dulness at bases of lungs, extending as high as inferior angle of scapula on both sides. Vocal resonance and fremitus absent.


Treatment. In addition to the ordinary orthodox treatment for nephritis, a nephrectomy was performed upon the patient, thrice, on
account of arthropoda, with good results. He was aspirated on occasions, 278 ounces of fluid being removed from abdomen and pleural cavities. He eventually left the infirmary, against advice.
Alexander Millands was admitted to R.I.P., complaining of pain in abdomen and left side of chest, and swollen feet. Duration nine weeks. Previous illnesses included Scarlet Fever, Measles, Whooping Cough, Small Pox and a vague history of Peritonitis. A year ago he fell down a well injuring his back, and after this his urine was discoloured. He experienced a chill about nine weeks ago, and had pain in his back, and noticed his feet and legs were beginning to swell. Oedema of eyelids is fairly noticeable.

Alimentary System. Appetite poor; thirst excessive; occasional vomiting. Abdomen is very distended and tense, with a large area of dullness on percussion, changing when patient changes his position.

Circulatory System. Heart is enlarged. There is reduplication of first sound in mitral area, with accentuation of pulmonary second sound. Pulse walls thickened and tension high.

Urinary System. Incontinence frequent; quantity small; average quantity 30 oz. per diem; colour dark smoky; Ur. 97 1018.
reaction acid; albumen present 2.625 gr per oz; peptone and globulin also present, with fatty and granular casts, and blood corpuscles; urine 167 gr per diem.

On account of tension of abdomen interfering with action of diaphragm, heart, etc., during the course of treatment, patient was aspirated on 10 occasions 766 oz. of fluid being removed between Nov. 1894 and January 1895, and he eventually left the Infirmary much improved.