

ARTIFICIAL PNEUMOTHORAX
IN THE TREATMENT OF PULMONARY TUBERCULOSIS.

by

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INTRODUCTION.

In the treatment of Pulmonary Tuberculosis various agents and methods have from time to time held sway; many, unfortunately, to prove themselves useless, and of benefit to no one except the maker of the particular remedy in vogue at the moment.

With the introduction of Artificial Pneumothorax, a method was produced which had the virtue of being on a physiologically sound basis, namely rest for the affected part. Even this may be argued against, and the example of the meninges quoted; for although physiologically at rest, there is no tissue in which tuberculosis runs a more rapid and more intractable course. Doubtless however it has always been recognised as a broad principle that an inflamed tissue requires rest.

This is easily obtained in the case of a limb, but the problem of obtaining rest for a lung is much more difficult, for here we are dealing with an organ which is constantly active, and over which the will has practically no power, but which is controlled by such purely automatic mechanism as the CO₂ Content of the blood, and the pressure on the vagus nerve-endings in the lung.

It/

It is therefore obvious that the only way in which a lung can be rendered inactive is by pressure from without, and it is with the purpose of exerting this necessary pressure that a gas is allowed to flow into the pleural cavity, that is to say that the operation of Artificial Pneumothorax is performed. This operation has been carried out extensively in America, on the Continent of Europe, and in our own country. The results have varied greatly, and it is to give an actual experience of a limited number of cases that this thesis has been written.

It is well to state that in the present series, the results have been on the whole unfavourable, despite the fact that cases were carefully selected.

Very careful examination of the chest was made in every instance, but as no X-ray apparatus was available in the hospital; physical examination had to be relied on, excepting in a very small number of cases which were well enough to be sent to the dispensary for X-ray examination.

In only two cases could one be sure of a definite improvement which would probably not have taken place otherwise.

The results given by various workers have been collected, but these are subject to criticism, as insufficient time has elapsed, and many of the cases were/

were lost sight of; that is to say, the end histories are not known.'

In mitigation of the unfavourable results obtained, it should be mentioned that the operation was only done in cases where all other means had failed, and where the disease was active and progressive, with the patient's general condition steadily becoming worse.

HISTORICAL.

In 1820 James Carson read a paper on "the elasticity of the lung" before the Literary and Philosophical Society of Liverpool, which article can be seen in a book of pamphlets entitled "Voyage Medical en Italie". Next year (1821) he submitted to the Society a further paper on the same subject, in which he foreshadowed the operation of Artificial Pneumothorax as now carried out, but he appears never to have actually attempted it. In this paper¹ he says "As soon expect healing in a divided Tendo Achilles without mechanical aid" and later "A wound or abscess in the lung would be placed in circumstances at least as favourable to the healing process as the same affection in any other part of the body".

A few years later Dr H.F. Ramadge purposely punctured the pleural cavity in a case of ulcerous phthisis, but his result was received with considerable scepticism, as at that time he had earned a considerable notoriety, and was more or less ostracised by his fellow practitioners.

In 1885 Cayley² performed the operation of Artificial Pneumothorax in a case of severe and recurring haemoptysis and read a paper on the subject in 1885. The attempt was temporarily successful, but/

but the patient died later of syncope.

It is of interest to notice that the nature of the criticism at the reading of this case showed that the possibilities of Artificial pneumothorax were well known to medical men in the "eighties".

About this time and quite independently, Potain in France and Stokes in Ireland had grasped the idea of Artificial pneumothorax as a therapeutic measure, and had actually performed the operation. At a period very little previous to this, Spontaneous pneumothorax was regarded as almost always fatal, but Herouard at the French Congress in Algiers in 1881 published two cases showing the healing effect of Spontaneous Hydro-pneumothorax. Potain in 1885 injected sterilized air into the pleura to maintain the collapse when withdrawing the fluid in these (3) cases of Spontaneous Hydropneumothorax and in his report he says

"La pneumothorax est une maladie qu'il ne faut pas guerir"³.

Forlanini's work was contemporaneous with and partly inspired by Potain's efforts. He read a paper in 1882 which was entirely theoretical, but in 1888 he injected air into the pleura in a case of one-sided Pulmonary Tuberculosis, and published this case in the Gazette Medical di Torino; while in the following year he published in that journal a case of cure by the same method.

J.B. Murphy⁴ in America in 1898 published five cases of Artificial pneumothorax, two unsuccessful and three temporarily improved but lost sight of. Next year Lemka⁵, a pupil of Murphy's, reported 53 cases of Artificial pneumothorax, Nitrogen being the gas employed. The histories are unfortunately very incomplete.

Murphy's work appeared to have been lost sight of, but the attention of Brauer in Germany was attracted by it, and in 1905 and 1906 he published cases in the "Deutsche Medezinische Wochenschrift" and in the latter year (1906) A. Schmidt published a case in the same journal.

Brauer's work put Artificial pneumothorax on a more rational and safer basis than previously, as he introduced the water manometer and this allowed the operation to become much more widely practised.

In this country Dr Claude Lillingston⁶ may be regarded as the pioneer. He writes that while a patient at Mesualien Sanatorium in Norway in 1909 his attention was drawn to the operation and he decided to undergo it. As a result his temperature fell, cough and expectoration diminished and the following year he was sufficiently recovered to return to England and to resume his work. In 1910 he performed Artificial pneumothorax on a patient in St Mary's Hospital/

Hospital and a complete recovery took place.

In the above sketch I am indebted to E. Rist⁷ for the bridging of several gaps in the history.

REFERENCES.

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2. Cayley, W. Notes on a Case of Haemoptysis treated by the Induction of pneumothorax. Transaction of the Clinical Society of London 1884-1885. British Medical Journal 1885. p.991. Lancet. 1885. p.894.
3. Potain. "Des injections intra-pleurales d'air sterilosé dans le traitement des éparchements pleurauz consecatif au pneumothorax". Bulletin de l'Academie de Medicine 24th April 1888.
4. Murphy, D.B. "Surgery of the Lung" Journal of the American Medical Association 1898. XXXI. 151. 208. 281.
5. Lemhre. "Report of a case of Pulmonary Tuberculosis treated with intra-pleural injection of Nitrogen". Journal of American Medical Association. 1899. XXXIII.
6. Linningston, Dr C. Practitioner 1913.
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INDICATIONS AND CONTRA-INDICATIONS.

The classical case for treatment by Artificial Pneumothorax is that of one sided active and advanced disease, with the other lung showing no signs of involvement by the Tuberculous process. This is an ideal which occurs in only a small percentage of cases, as in the common apical type of disease the Tuberculous process usually invades the other apex at an early date. It is noteworthy that in suitable cases the disease as a rule is widely scattered throughout the affected lung, and cavitation if it should occur is frequently basal or in the axillary region, but not apical as is usual in the ordinary case of Pulmonary Tuberculosis in adults.

The percentage of suitable cases as computed by various observers varies, but by taking an average of the statistics of Keller, Ferrio, Fishberg, Bernard and Courrant, the figure 7.2% was arrived at out of a mixed phthisis population. A careful record has been kept of the cases admitted to this hospital and in only 3% of those admitted has the chest condition been such as to lend itself to possible improvement by the operation of Artificial Pneumothorax.

These statistics are misleading however because had the patient been under continuous observation from the/

the period of contracting the disease, a time might possibly have been selected when Artificial Pneumothorax would have been of value.

Having stated the ideal case, it is well to go on to cases in which the conditions are not so good but still possible of improvement by this method.

Disease in the comparatively sound lung if limited and inactive, is not regarded as a contra-indication.

As a treatment of recurring haemoptysis Artificial Pneumothorax is theoretically ideal, and has been employed by various workers. Unfortunately no suitable case has occurred here, but Rautenberg^s amongst others has reported on two cases so treated. The haemorrhage was controlled for a time but the patients ultimately died.

Amongst the complications of Pulmonary Tuberculosis, Laryngeal Tubercle (if not too advanced), is said to frequently improve under the treatment; the inference ^{FRANK} of laryngeal cases treated here has not however been favourable. To consider the contra indications.-

- (1) Widespread and active disease of both lungs is of course absolute, but certain workers have attempted alternate and partial collapse of both lungs in the hope of alleviating symptoms.

- (2) Dyspnoea if of purely toxic origin may be improved by the operation, but if accompanied by cyanosis it is a strong contra-indication, as the latter condition suggests embarrassment of the right side of the heart, and this would be still further embarrassed by diminishing the Pulmonary vascular area and decreasing the venous suction exerted by the elasticity of the lung.
- (3) In early phthisis, one hesitates to subject the patient to the risk and protracted treatment involved in artificial pneumothorax, without giving sanatorium treatment a fair chance; and it is reported⁹ that the liability to pleural shock is greater when one is dealing with a sound pleura.
- (4) Intestinal Tuberculosis if at all marked is an absolute contra indication, as is also disease of the circulatory organs or kidneys.
- (5) Amongst those suffering from the more generalized diseases, the victims of diabetes should not be subjected to Artificial Pneumothorax, as any wound in these patients is liable to be very slow in healing, the risk of sepsis is greater, and the Tuberculosis may be a terminal stage - a complication as it were of the diabetes.

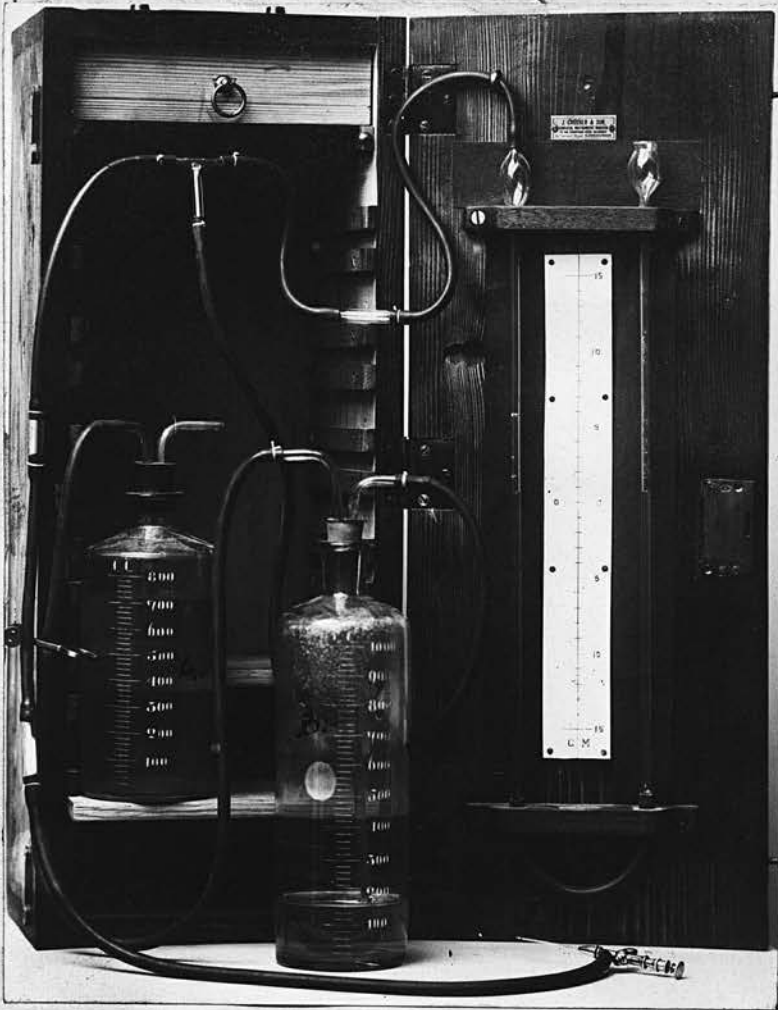
(6)/

(6) Of local conditions, the presence of adhesions so widespread and dense as to render collapse impossible negatives the operation. The diagnosis of adhesions generally requires an X-ray examination, and it is in the eliminating of this condition that preliminary X-ray examination is so useful.

Recently it has been suggested that the adhesions might be dealt with surgically¹⁰ and Artificial Pneumothorax performed later. This was attempted here in a case of bronchiectasis a year ago, the adhesions being divided by Mr John Fraser, but the walls of the cavity proved too hard to permit of collapse.

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8. Rautenberg. "Zerte f. Tuberkiel. April 1920. XXXII. No.1.
9. Clive Riviere. Pneumothorax treatment of Pulmonary Tuberculosis.
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DESCRIPTION OF THE APPARATUS.

The above photograph is almost self-explanatory, but a brief description of the more important points is given. Bottle A is the pressure bottle and bottle B the gas bottle, the latter bottle being narrower and longer than A so that the variations in the level of fluid may be more easily seen. The bottles are half filled with a weak antiseptic solution, e.g. a weak/

weak solution of perchloride of mercury. The corks used are of rubber and each is penetrated by two holes. Through these in bottle A runs a long narrow glass tube extending almost to the foot of the bottle, and a short bent tube communicating with the outside air. The cork in bottle B is pierced by a long tube as in bottle A and by a short bent tube, the latter however being connected to the rubber tubing. The bottles are graduated in 100 cc. from below upwards, and are connected by a piece of rubber tubing to which a clip is attached. The gas bottle B is connected with the cannula by means of rubber tubing, into the continuity of which one or more pieces of glass tubing plugged with sterile cotton wool may be inserted, and a glass T piece connecting up the water manometer.

The manometer consists of two upright glass tubes with bulbous upper ends, the lower ends being connected by a piece of rubber tubing. The upright tubes are graduated into cubic centimetres. The bulbous ends prevent the water from being blown out of the manometer by any sudden expiratory act on the part of the patient.

PHOTOGRAPH OF TROCAR AND CANNULA.

The cannula used is one of a diameter of 1.4 millimetres. It has a lateral piece to which the rubber tubing can be attached and a stopcock to be closed when the trocar is withdrawn. At its tip it has two openings, a terminal and a lateral.

Briefly/

Briefly the mode of use of the apparatus is that fluid is allowed to syphon from bottle A to bottle B from which it displaces the air driving it via the rubber tubing and cannula into the pleural cavity.

THE GAS TO USE.

The essential characters of the gas is that it shall be non-toxic and that it shall be absorbed slowly by the pleura, so that collapse of the lung may be maintained a considerable time without repeating the operation.

Davey¹¹ in 1823 made an analysis of the gas found in the pleural cavity in a case of spontaneous pneumothorax and he gave that as 8 parts CO₂ and 92 parts of Azotic Gas.

This led him to experiment with various gases as to their rate of absorption by the pleura. From these experiments he concluded that oxygen was absorbed more rapidly than Carbonic Acid gas and the latter more rapidly than the Azote.

He introduced into the pleura of a dog a gas consisting of.-

20 parts CO₂

63 parts Azote

16.8 Oxygen Gas

On recovering this after 24 hours he found:-

18.3 CO₂

78.3 Azote

3.4 Oxygen.

He experimented with various gases and finally concluded that Nitrogen was the least rapidly absorbed by the pleura. This result has been verified by many other observers, so for a considerable time Nitrogen was the only gas used in Artificial pneumothorax.

This required special apparatus and at the present day Atmospheric Air is the gas generally used. It is easy of manipulation, costs nothing and its composition is approximately

Oxygen	20.94	Nitrogen	78.09
Argon	0.94	Carbonic Acid	.03

so that its rate of absorption is not much faster than nitrogen.

Air has been used in all the operations of Artificial Pneumothorax performed in this hospital.

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11. Davy, J. (London) Philosophical Transactions. 1823. CXIII. 496.
"Observations on air found in the pleura in a case of Pneumo-thorax with experiments on the absorption of different kinds of air introduced into the pleura".

TECHNIQUE OF THE OPERATION.Preparation of the Patient.

This need not be elaborate. A light breakfast is allowed and half an hour before the operation $\frac{1}{4}$ gr. of Morphia is given hypodermically; this allays nervousness and diminishes the risk of pleural shock.

The operation. Two tables are used. One, on which stands the pneumothorax apparatus, is placed on the side of the bed opposite the operator, so that the fluctuations in the manometer may be watched without the necessity of looking to either side. The other table stands at the side of the operator and is covered with a clean towel. On this table, lying in a vessel containing methylated spirit are the trocar and cannula, two hypodermic syringes, and a tenotomy knife.

There is also a spirit lamp, a bottle containing a diffusible stimulant, and another containing a 3% solution of eucaine.

The second hypodermic syringe and the diffusible stimulant are at hand in case of an emergency arising. The operation must be conducted with the most careful asepsis.

The patient lies on the sound side with a narrow hard/

hard pillow under the lower ribs, and the arm of the affected side is held above the patient's head by a nurse; this opens the intercostal spaces to their fullest extent. The site of the operation having been selected, usually in the region of the 6th space in the axillary or post-axillary line, that area is cleared up with spirit, painted with Tincture of Iodine and surrounded by sterile towels. The skin is now drawn tightly upwards and one cubic centimetre of the Eucaine Solution is injected by a hypodermic syringe. A skin bleb is first made by allowing a small amount of the solution to run in just under the epidermis, and the needle is now pushed vertically downwards between two ribs allowing the solution to infiltrate the needle track. When the pleura is reached the patient usually has a painful sensation and the operator may feel some resistance. At this level, the remainder of the eucaine is injected and the needle is now withdrawn.

The cannula, with the trocar in position, is now taken out of the methylated spirit and passed through the flame of the spirit lamp until thoroughly dry. The end of the rubber tubing, is then attached to the lateral piece of the needle, and secured by tying with linen thread.

The skin is again drawn tightly upwards, the motive/

motive being that when it falls back to its original position the connection between the pleura and the surface may not be a direct one. A small incision is made with a tenotomy knife over the bleb caused by the eucaïne. The trocar and cannula is now pushed gently downwards as was the hypodermic needle and when near the pleura the trocar is withdrawn and the stopcock turned. The cannula is now pushed on and a distinct resistance is noticed when the pleura is reached, and as it is penetrated there is a sudden lowering of the resistance and a snap may be heard. In the meantime the assistant has allowed all the fluid excepting 100 cc. to syphon from the gas bottle into the pressure bottle. He ought also to have made sure that the rubber corks are tight and to have adjusted the clip on the tubing between the bottles.

When it is presumed that the pleural cavity has been entered the assistant pinches the rubber tubing on the bottle side of the glass T. piece, thus disconnecting the manometer from the gas bottle and allowing the full amplitude of the intrapleural pressure to be recorded. If the amplitude is such as to indicate with certainty that the cannula is in the pleural cavity, the clip between the bottles is released and the fluid syphoning from the pressure bottle/

bottle to the gas bottle displaces the air and forces it into the pleural cavity via the rubber tubing and cannula.

A negative pressure on the manometer of 6 to 8 cc. water with a clean respiratory fluctuation of 4 to 8 cc. is a clear indication that the pleural cavity has been entered.

The rate of flow of air is controlled by varying the levels of the bottles and to commence with a high pressure should not be used.

As regards the amount of air allowed to enter at the first operation, most authorities now recommend that not more than 500 cc. should be introduced otherwise a distressing dyspnoea may supervene.

This of course does not apply when a rapid and complete collapse of the lung is required as in the treatment of haemoptysis.

A sufficiency of air having been introduced the assistant adjusts the clip on the tubing between the bottles and the operator withdraws the cannula. It is well to knead the skin in the operation area between the fingers to obliterate the needle track: then the puncture is sealed with collodion.

When a large amount of air has been introduced it is advisable to apply a tight pad over the operation area, as this has the effect of reducing the/
the/

the risk of surgical emphysema which tends to be caused by the patient coughing.

The trocar and cannula are now removed from the rubber tubing, and the end of this latter is plugged with a sterile glass end piece.

To maintain collapse of the lung the operation must be repeated at intervals varying directly with the rate of absorption of the gas used. In the case of air an interval of a week may be allowed to elapse before the first refill is given, and this period can be gradually extended between subsequent refills, and it is well to gradually increase the amount of air allowed to enter the pleural cavity. In this hospital the refills are conducted on exactly the same manner as the original operation, using the same apparatus.

Certain workers use a fine hollow needle for refills instead of the trocar and cannula. Contending that there is no danger of the lung being wounded as it is already collapsed, the only advantage of this is that it is said to be less painful, but even with a trocar and cannula there is remarkably little pain if the area is properly anaesthetized and the operator is sufficiently practised.

DIFFICULTIES, COMPLICATIONS AND DANGERS.A. DIFFICULTIES.(1) No Manometric Response.

The pleura having been penetrated the expected manometric response may not occur, in consequence of

- (a) Blocking of the cannula. This can be eliminated by passing the trocar.
- (b) Adherent pleura. This is a more common cause, and in this case it is well not to push the cannula any further, as the lung parenchyma or a vessel may be entered. The better procedure is to withdraw the needle and repeat the operation at another site. X-ray examination before the operation helps to eliminate this difficulty.

(2) Insufficient Manometric Response.

This is usually due to the presence of less dense adhesions, but it is unsafe to allow any air to flow as the cannula may be in a vessel or in the lung parenchyma, in which case there is a small fluctuation in the manometer.

Again the wise course is to select a fresh site and repeat the operation.

(3)/

(3) Production of Sudden Positive Pressure.

It occasionally happens that a clean and sufficient fluctuation of the fluid in the manometer is obtained but after a small quantity of air is allowed to flow a positive pressure is recorded.

This suggests that the cannula is in a pleural pocket, and attempts may be made to break down the circumscribing adhesions by raising the pressure bottle, and thus increasing the force with which the air is entering. Should this manoeuvre be successful, it will be signified by a sudden negative pressure in the manometer and a reinstatement of the large respiratory fluctuations.

B. COMPLICATIONS.(1) Pleural Effusion.

This occurred in some degree in all cases here in which Pneumothorax was maintained for a period exceeding 6 months. In one case it was very troublesome and a large quantity of fluid still persists in the pleural cavity after repeated tappings.

(2) Dyspnoea.

This occurred frequently especially after a large injection of air but in no case was it really distressing or alarming.

(3)/

(3) Displacement of the heart occurred in two cases.

There was no untoward symptom,
but the pulse rate was accelerated.

C. ACCIDENTS OF TREATMENT.

(1) Spread of the disease to the sound lung has been of frequent occurrence, as has renewed activity in quiescent lesions in the other lung. This has been the most common cause of failure in the unsuccessful cases. Whether this spread was due to the operation is debatable, but for the sake of lucid classification it has been included under accidents.

(2) Surgical Emphysema.

This has occurred slightly in several cases, and is usually due to the patient coughing and expelling some of the air from the pleural cavity. This can be partly prevented by applying a tight pad after the operation and obliterating the needle track as far as possible. In one case a slight degree of surgical emphysema was caused by accidentally allowing a small quantity of air to flow after the needle had been withdrawn from the pleura.

(3)/

(3) Haemoptysis.

Slight staining has occurred in several cases but no decided haemorrhage.

(4) Pleural Shock.

In one case, the patient showed symptoms of collapse almost as soon as the cannula was introduced. No air was allowed to flow and the cannula immediately withdrawn. The patient died and the cause of death was presumed to be pleural shock.

(5) Spontaneous Pneumothorax.

This occurred in one case fortunately on the same side as the artificial, so that the effects were beneficial in as much as the collapse was maintained for a long period without the necessity of giving a refill.

The following complications and accidents have been reported by various operators. Crockett¹² gives the following as having occurred in a series of 80 cases.

Hydrarg. Perchloride solution sucked into pleural cavity - one case.

Two cases of dyspnoea and cyanosis after a large refill.

Two cases of air embolism, one proving fatal and at the post-mortem examination air bubbles were found on the surface of the brain.

One case of Cardiac Asthma presumably due to pressure.

In a report on 1122 cases under the care of 24 American workers, the following accidents and complications took place.¹³

Pleural Effusions	113
Bleeding of other lung	7
Extension of Tuberculous process to other lung.	38
Pleural Shock	26
Air Embolism	3
Spontaneous Pneumothorax	10
Bilateral Pneumothorax	2
Pyo Pneumothorax	13
Cardiac Dilatation and heart failure	4
Torsion of heart and blood vessels	1
Total	<u>217</u>

Cetrangolo¹⁴ gives the following accidents as having arisen in his series of cases.-

Subpleural and Subcutaneous emphysema. Secondary valve formation. Gas embolism. He adds that in his opinion all the disagreeable accidents associated with artificial pneumothorax are not published.

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REFERENCES.

12. James Crockett, M.D. "Artificial Pneumothorax in Pulmonary Tuberculosis".
Edinburgh Medical Journal.
 13. Medical Annual 1922. (Vide Tuberculosis).
 14. Cetrangolo. An Article in the Semana Medica of Buenos Aires, quoted in the Journal of the American Medical Association, 1920, page 836.
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DETAILED ACCOUNT OF SIXTEEN CASES

TREATED AT EAST PILTON HOSPITAL.

Case No.1. S.B., female, age 21. Admitted 6th May 1921.

T. 102.4.

Sputum 3ss.

Weight 9 stone 3 lbs.

Advanced and active condition in right lung.

Left lung clear of physical signs of disease.

6.6.22. A.P. attempted. Sensation of entering solid lung. No amplitude in manometer.

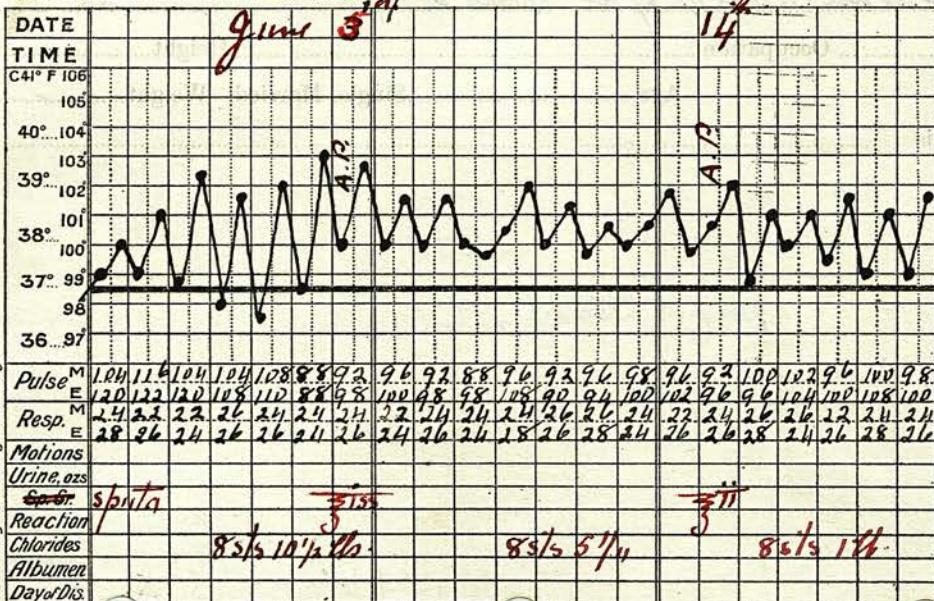
14.6.22. A.P. attempted. Manometer recorded + 2 to - 2. Insufficient amplitude.

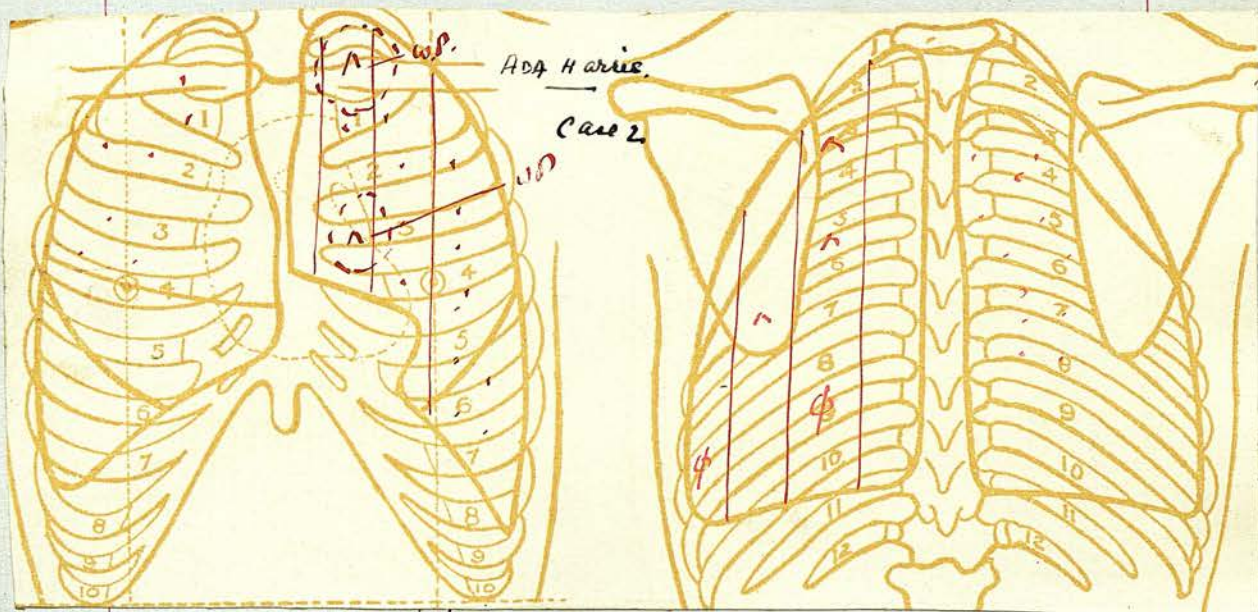
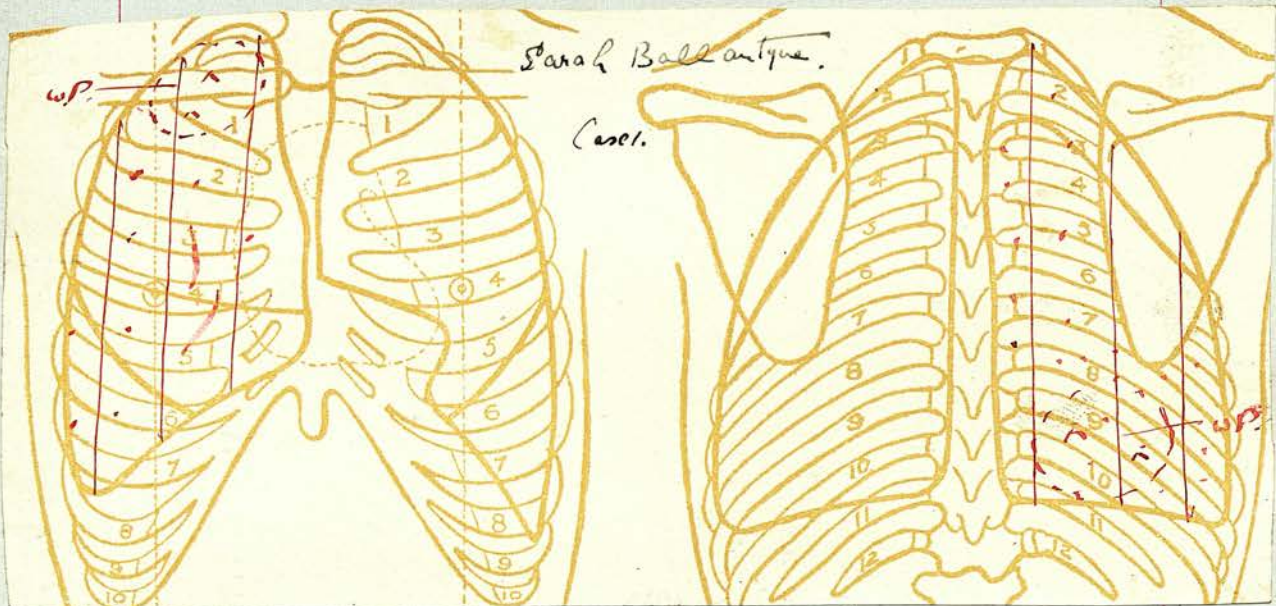
Active disease became manifest in left lung.

Attempts discontinued.

Patient died 19th July 1922.

NAME Sarah Ballantyne





Case No.2. A.H., female, aged 19.

Admitted 18th January 1922. Weight 5 stone

10 $\frac{1}{4}$ lbs. Sputum $\frac{3}{2}$ II. T.B. + .

Temperature 101.5. Advanced one-sided disease with occasional crepitation in other lung.

Artificial Pneumothorax 9th Feb. 1922.

500 cc. Air.

Manometer 10 to 20 to - 2 to - 4.

13.2.22 A.P. Zero to -6 to Zero to +1. 800 cc. Air.

17.2.22 A.P. Zero to -4 to Zero to +4. 700 cc. Air.

27.2.22 A.P. Zero to -4 to +2 to +5. 1000 cc. Air.

³⁻
15.3.22. Zero to -4 to Zero to +5. 1150 cc. Air.

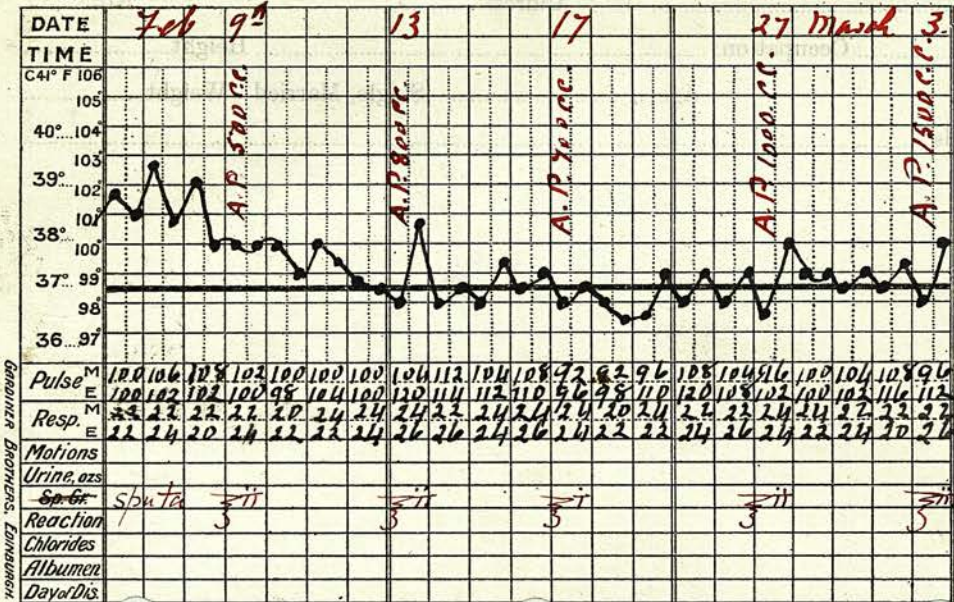
Temperature dropped on 1st April and has remained normal since. Patient has maintained a good general condition since. Heart displaced to right. A.B. in 3rd space right side. 1 $\frac{1}{2}$ " Mid sternal line.

Weight on 17th January 1923 was 6 stone 10 $\frac{1}{2}$ lbs.

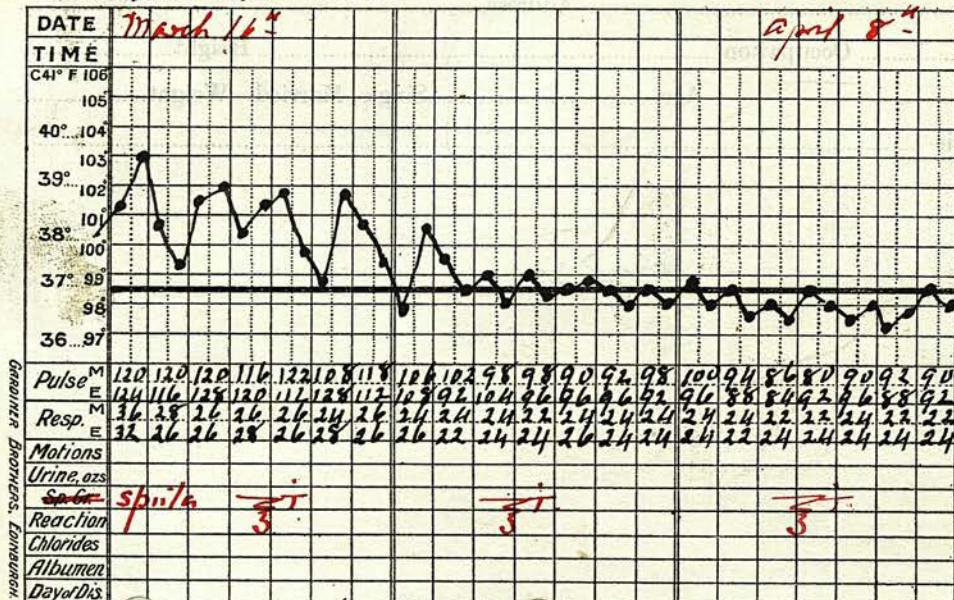
Sputum $\frac{3}{2}$ ss.

In this case a large pleural effusion developed and patient left hospital with a considerable amount of fluid still present and with the lung still collapsed.

NAME Ada Harris



NAME Ada Harris



Case 3. N.S., female, age 14 years. Admitted

9th June 1922.

Weight 5 st. 4 lbs. Sputum $\frac{3}{5}$ ss. T.B. + .

Temperature 103.

Advanced left sided disease with occasional crepitations in right side.

A.P. 14.6.22. 450 cc. Air. Zero to - 20. (Sobbing)
to Zero to - 4.

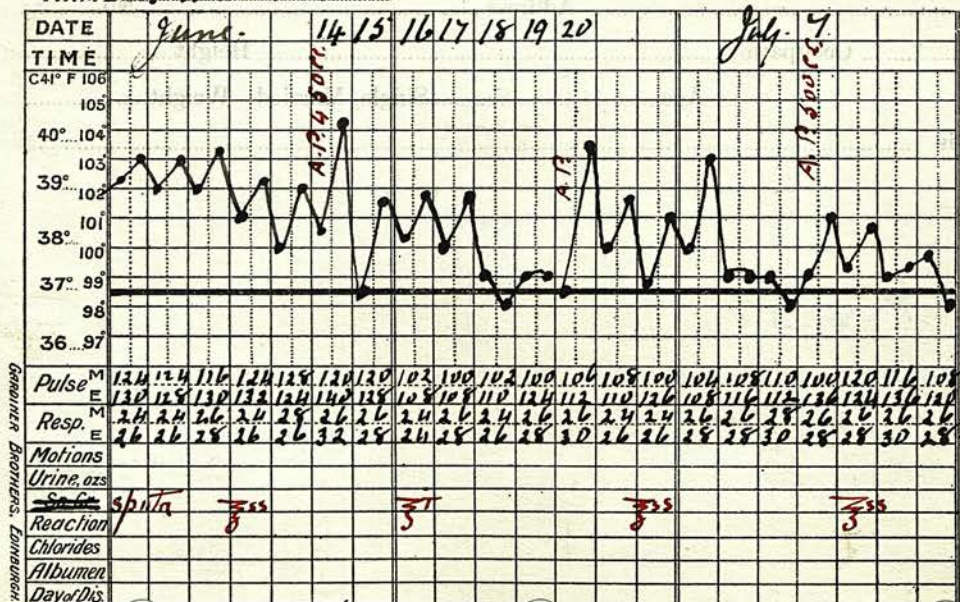
Slight surgical emphysema developed due to patient coughing.

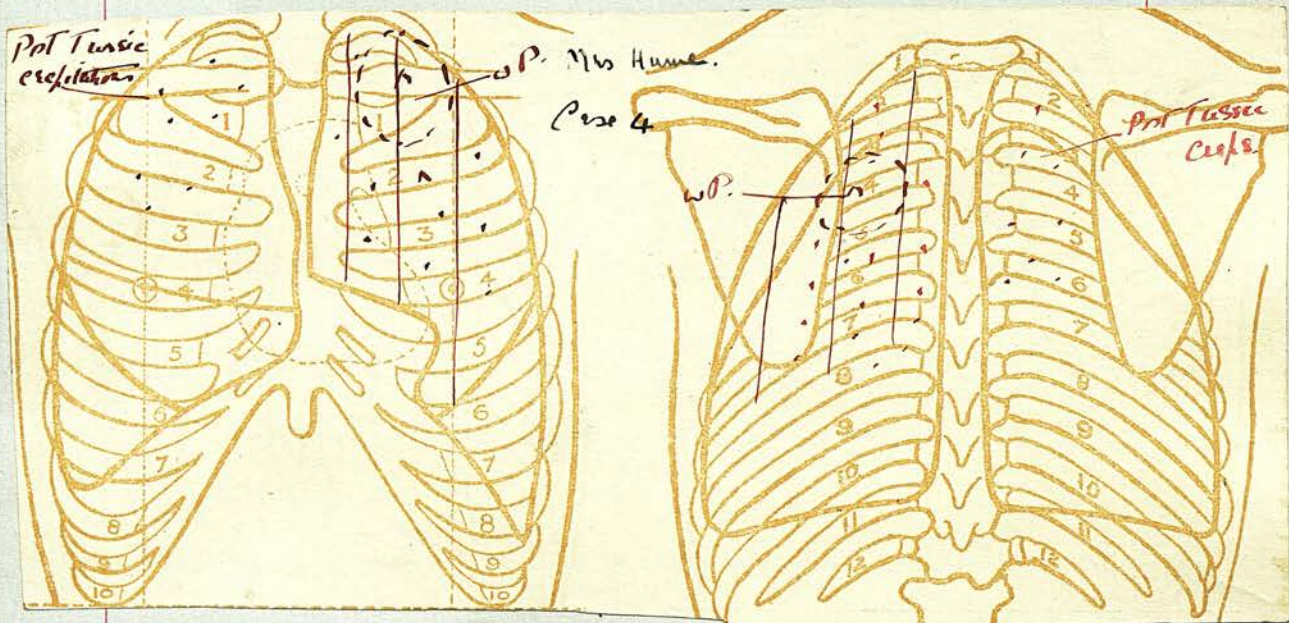
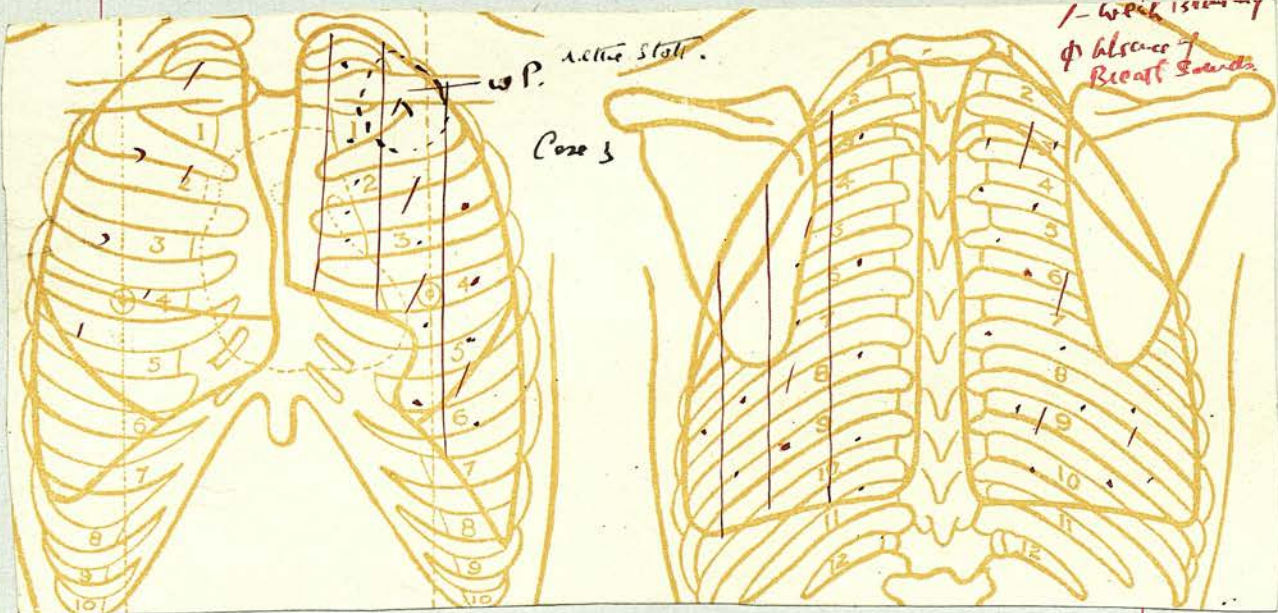
A.P. 22.6.22. Not sufficient amplitude. No air allowed to flow.

A.P. 7.7.22. - 3 to + 3 to + 2 to - 2. 500 cc. Air.

Active disease supervened in right lung so attempts had to be discontinued. She was discharged at own request on the 10th August 1922, and has since died.

NAME Netti Stott





Case No.4. Mrs M.H. Age 29.

Admitted 23rd May 1922.

Weight 7 st. 1½ lbs. T.B. + + .

Sputum 3I. Temperature 102°.

Advanced and active disease in left lung, crepitations at right apex and pallor of vocal cords with slight huskiness of voice.

23.6.22. A.P. attempted. Insufficient Manometric response.

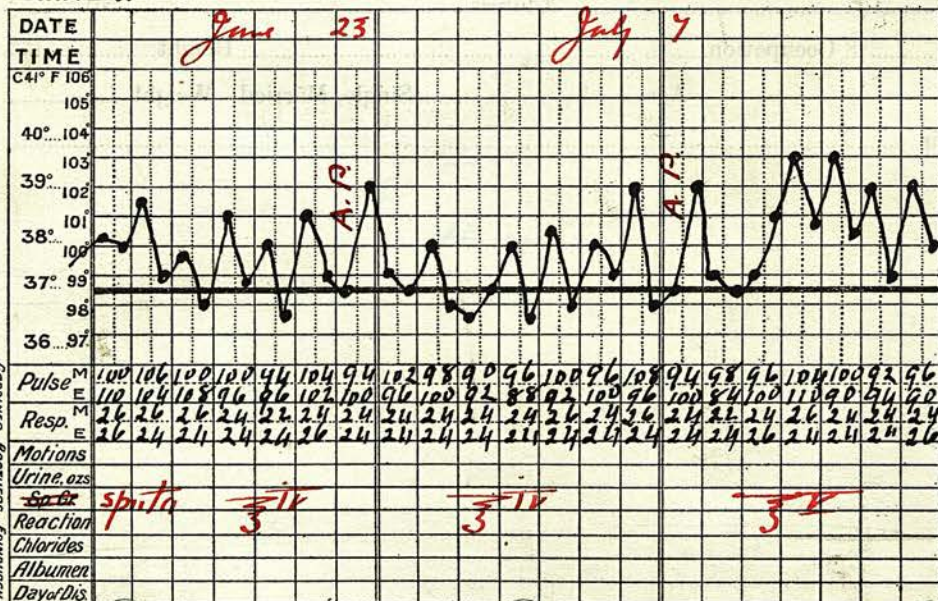
7.7.22. " " " " "

Patient still febrile and crepitations in right side are more numerous and bubbling.

Discharged at own request 21.9.22.

Patient has since died.

NAME *M^r Hume.*



GROUWER, BARNERS, LAMBUCH.

Case No. 5. N.D., female, age 19 years.

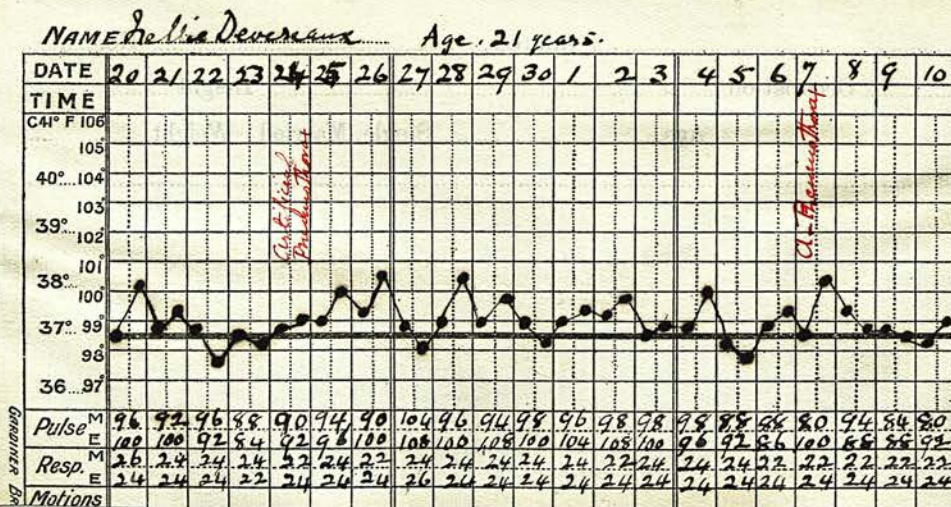
Admitted 27th May 1922.

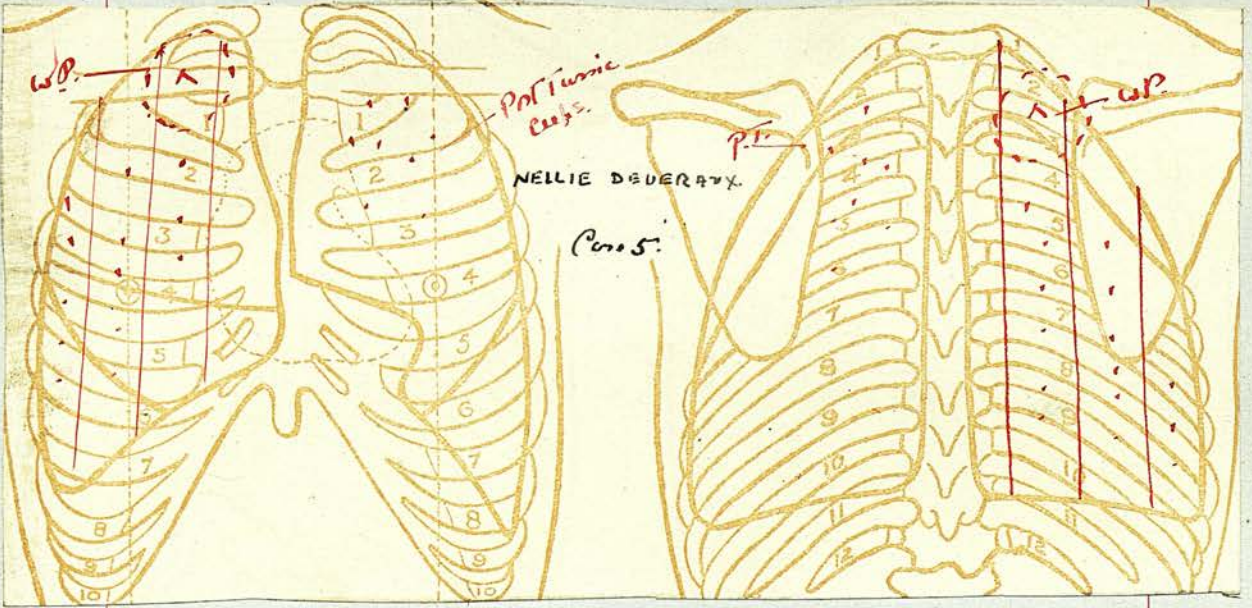
Advanced and active right sided disease with occasional crepitations at left apex. T.B.++. Weight 8 st. 1 lb. Temp. 101°. Sputum 3 II.

A.P. 23.6.22. Insufficient manometric response at first puncture. Another site was selected and an amplitude of Zero to - 6 was recorded. When air was allowed to enter great pain was complained of and a rapid positive pressure appeared, suggestive of adhesions. Attempt abandoned.

A.P. 19.7.22. Attempted. Steady negative pressure obtained with no respiratory fluctuation, and the sensation of having entered a solid organ was experienced. No air was allowed to flow. The disease in the left lung advanced rapidly and a marked degree of cyanosis developed.

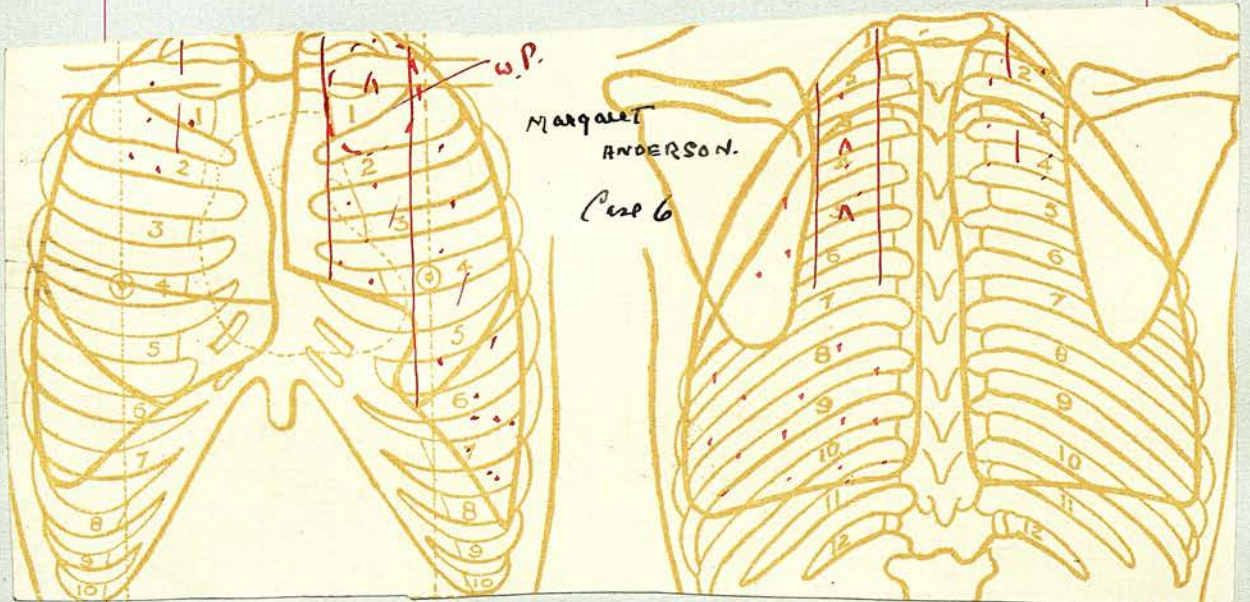
Patient died 23.1.23.





NELLIE DEVERAUX.

Case 5.



MARGARET ANDERSON.

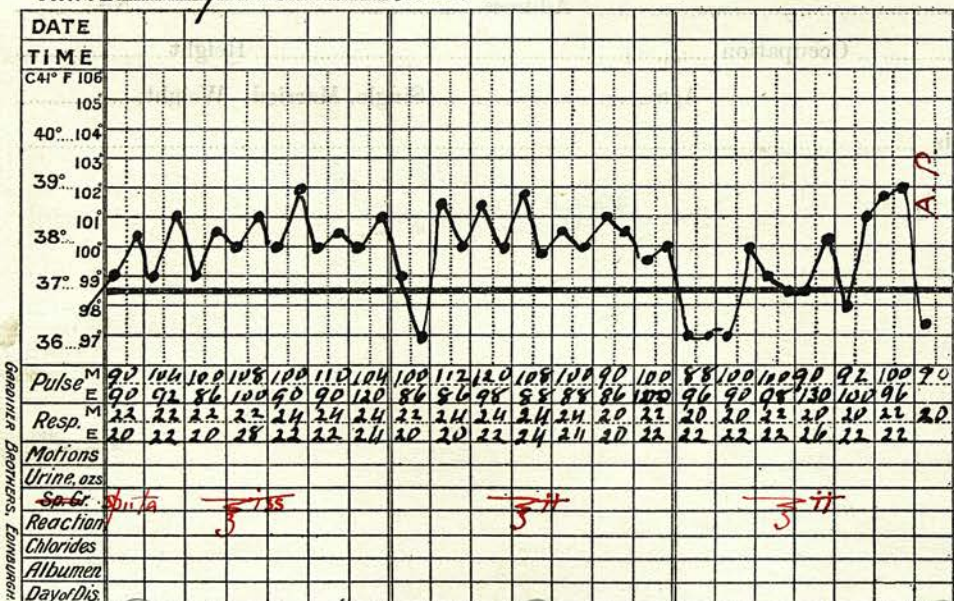
Case 6

Case No.6. M.A., female, age 22. Admitted 11th May 1922. Sputum 3iss. T.B. + + . Temp. 102°.

Patient was very ill on admission but as the more extensive and active disease was on the left side it was decided to attempt A.P. with the hope of delaying the process and alleviating symptoms.

A.P. 20.7.22. Entry easily obtained but no amplitude. No air allowed to flow. Patient suddenly showed signs of collapse so the cannula was immediately withdrawn. There was slight staining and the patient died in a few minutes despite all efforts at restoration.

NAME *Margaret Anderson.*



Case No. 7. I.S., female, age 19. Admitted 9.2.22.

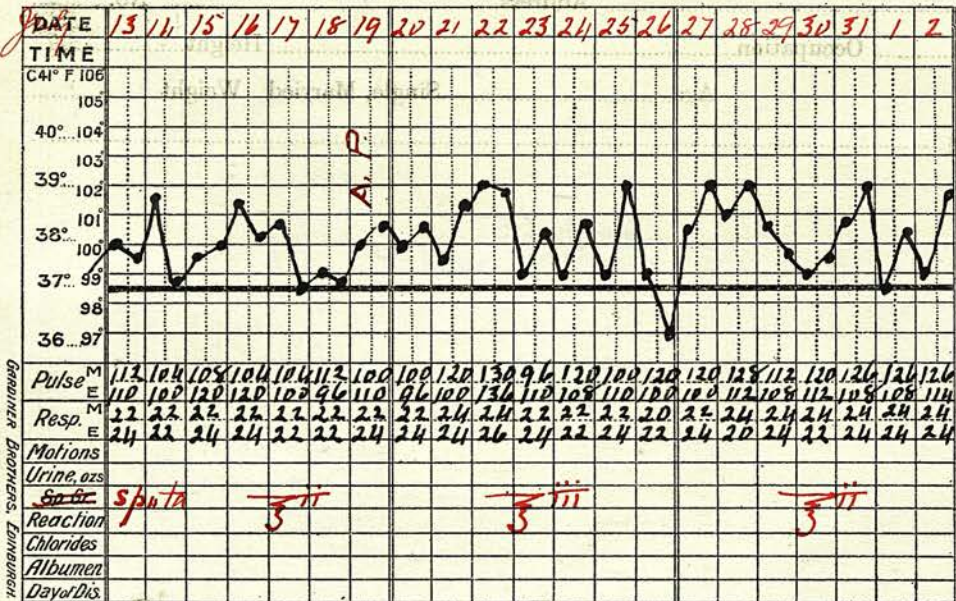
T. 101. Sputum 3ss. T.B. + .

Disease active and mainly left sided.

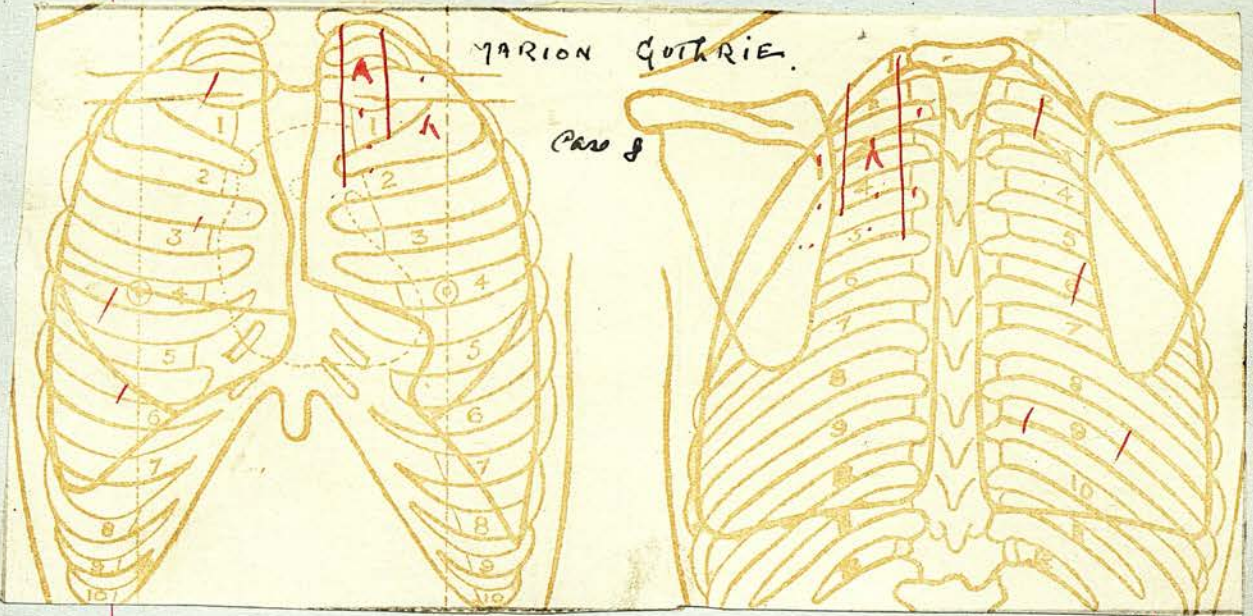
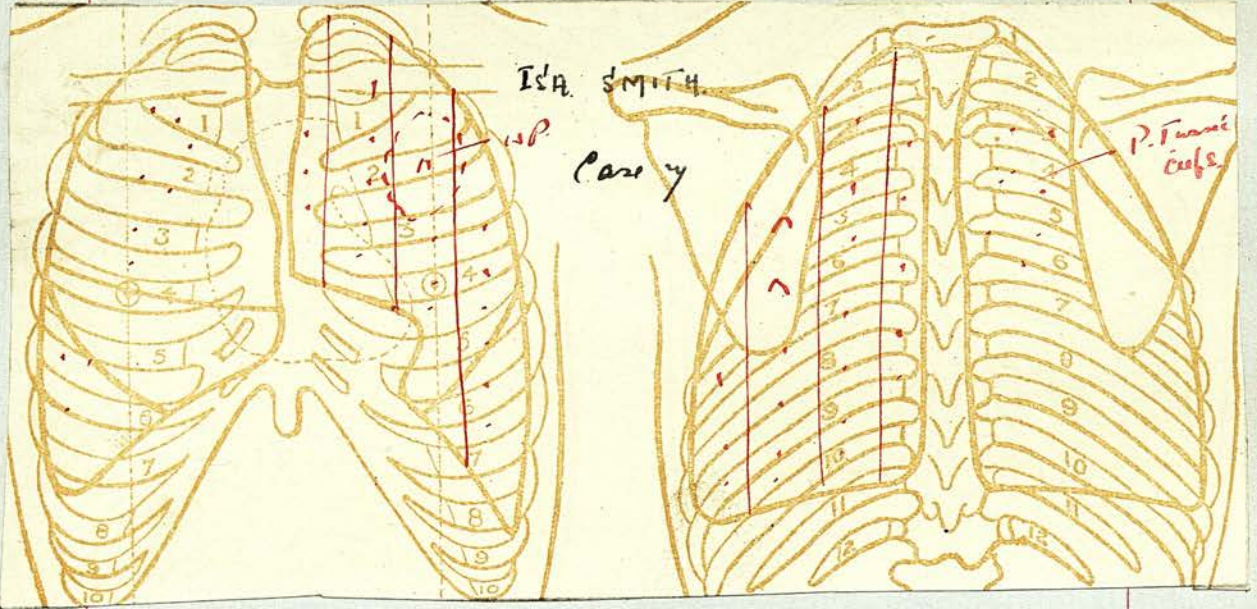
29.7.22. A.P. was to be attempted but after an injection of Cocaine this patient became so wildly excited that the attempt had to be given up.

The disease spread rapidly in the right lung and the patient died 18.10.22.

NAME Isa. Smith



GERMANY BROOKERS, LONDON



Case No. 8. M.G., female, age 25. Admitted 20.10.22.

T.B. + . T. 102.

Infiltration of left upper lobe with weak breathing throughout the right side.

22.11.22. A.P. 600 cc. Zero to - 8 to - 2 to - 4.

Slight surgical emphysema caused by patient coughing.

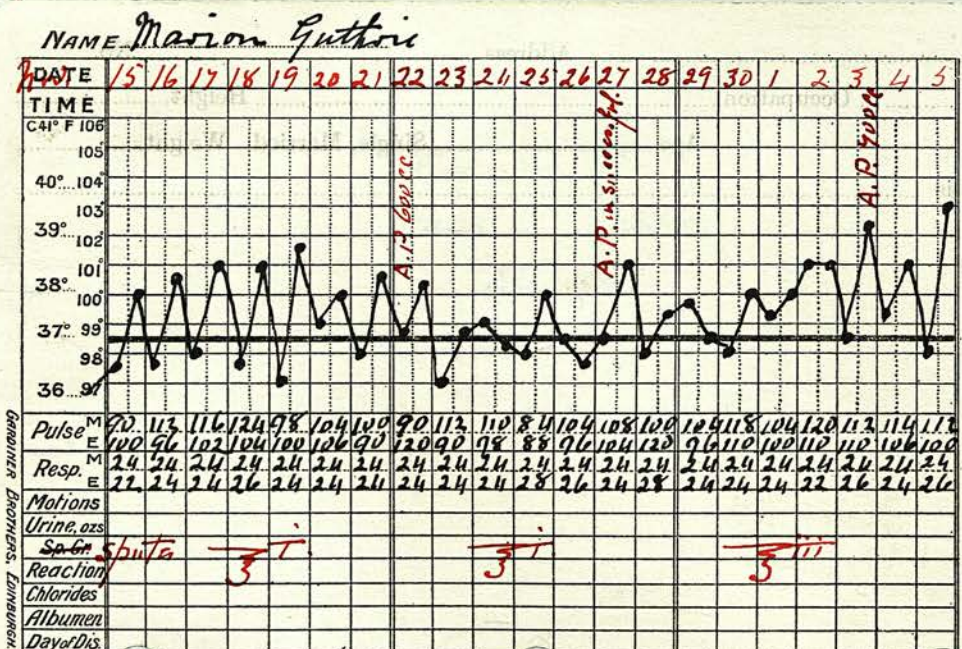
27.11.22. A.P. attempted. Insufficient amplitude.

1.12.22. First attempt unsuccessful. Insufficient amplitude. Second attempt 700 cc. air introduced.

Zero to - 5 to Zero to + 4.

Collapse almost complete. Small amount of fluid at left base. Temperature still swinging. T.B. + .

Patient refused further operation, and was allowed home at own request. Subsequent history not known.



Case No.9. Mrs I., age 52. Admitted 21.11.20.

T.B. - . Sputum 3 III.

Weight 6 stone $8\frac{1}{2}$ lbs.

Long standing condition mainly on left side. Temperature swinging slightly but no sign of recent activity excepting crepitations at left base. Slight cyanosis.

A.P. Zero to - 6. Zero to + 4.

A sudden negative pressure was recorded when 200 cc. had been introduced.

27.11.22. A.P. 850 cc. Zero to - 10 to + 2 to + 5.

The amount of sputum after this operation was 3 10 daily for several days.

4.12.22. A.P. 1300 cc. Zero to - 6 to Zero to + 3.

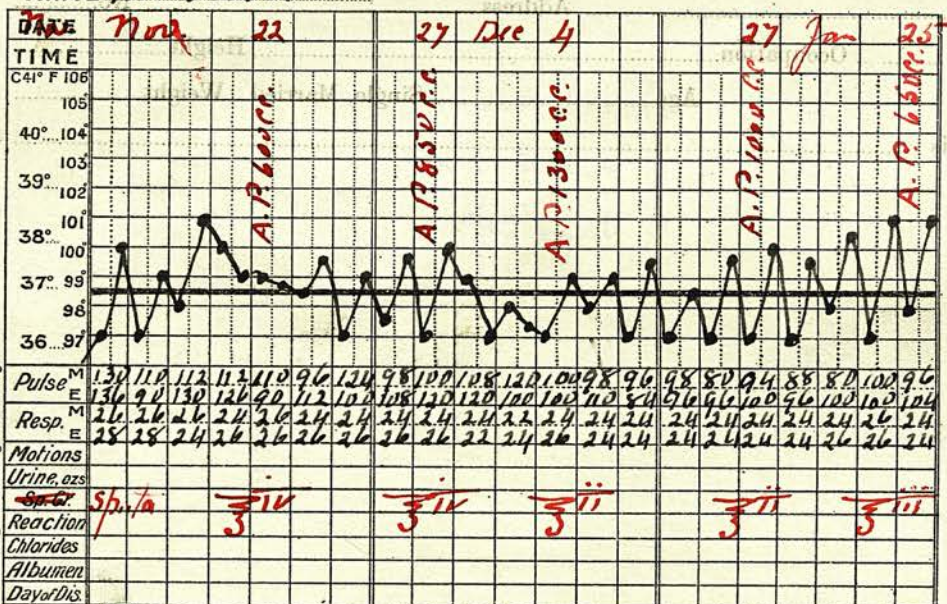
X-ray photograph at this stage showed lower part of lung well collapsed but upper portion of upper lobe still expanded and active.

27.12.22. A.P. 1000 cc. - 4 to - 8 to + 4 to + 6.

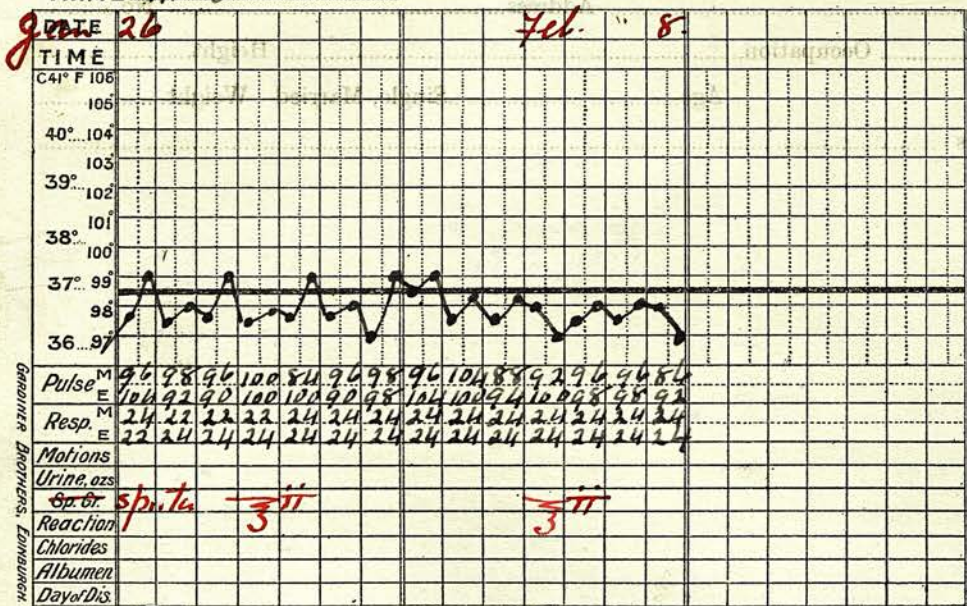
25.1.23. A.P. 650 cc. Zero to - 0 to + 3 to - 3.

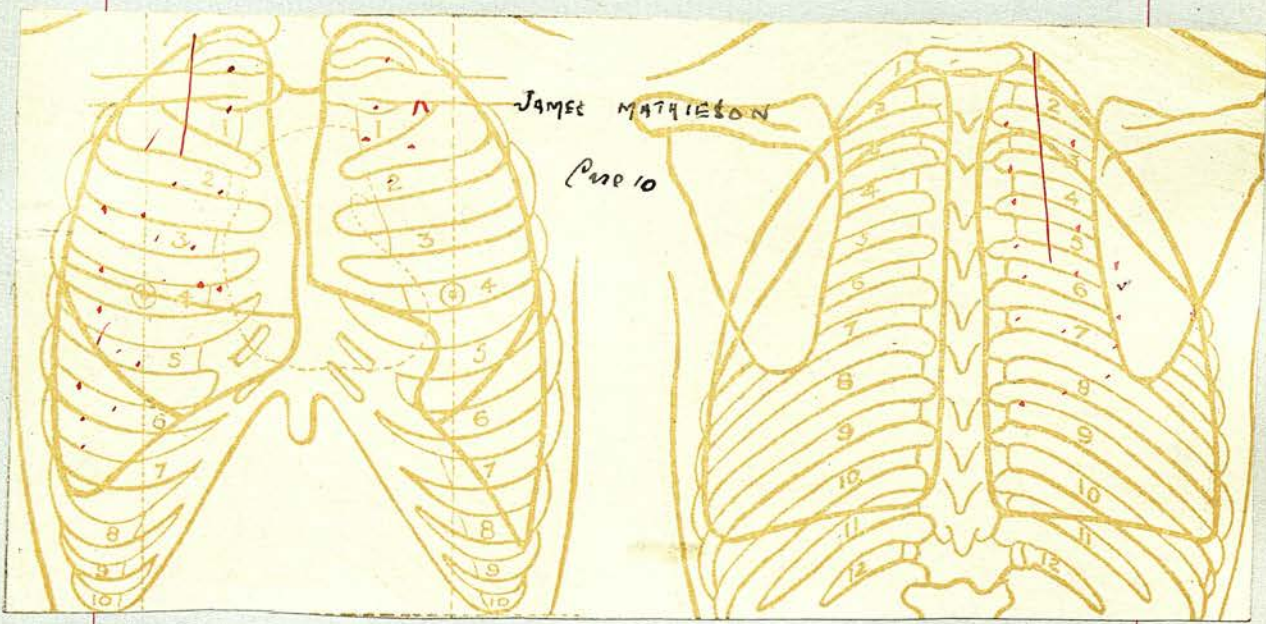
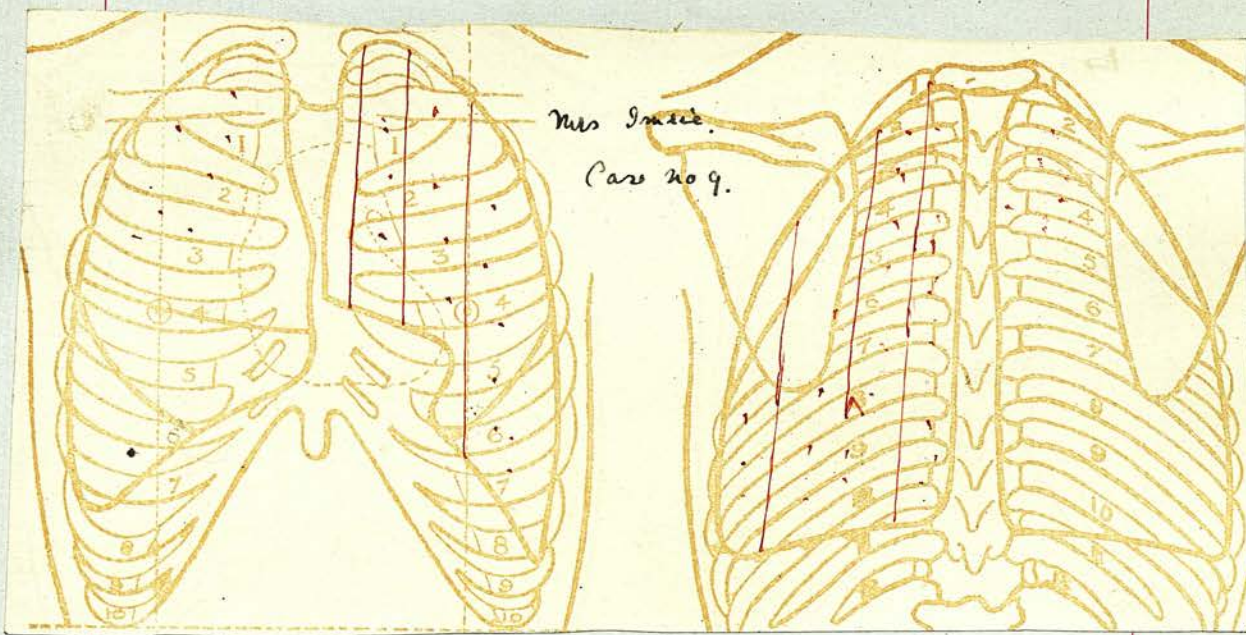
Pleural effusion has now developed. Weight 6 st. $8\frac{1}{2}$ lbs. Sputum 3 $\frac{1}{4}$. T.B. + . Cyanosis more marked. Condition much as on admission.

NAME M^r Jovic



NAME M^r Jovic





Case No. 10. J.M., male, age 26. Admitted 28.3.22.

T.B. + . Sputum $\frac{3}{4}$ IV.

Disease mainly on right side. Larynx involved. Tuberculosis is present below left arytenoid cartilage: this latter is swollen and inflamed. Left cord thickened and fleshy; very congested and fixed in position of abduction.

7.4.22. A.P. 600 cc. 0 to - 8 to - 2 to + 2.

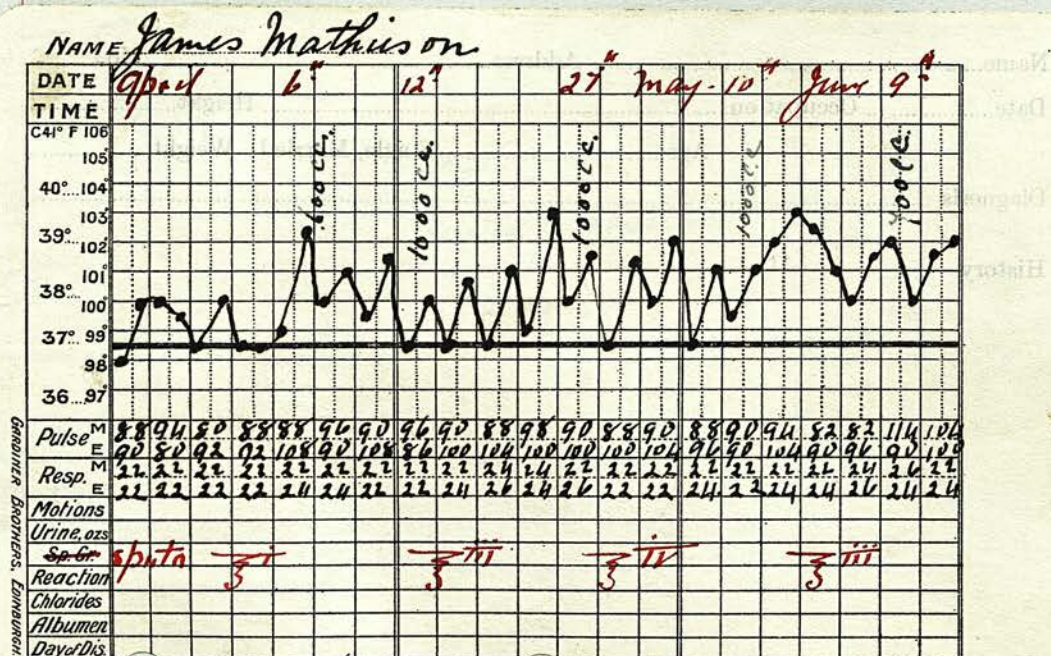
12.4.22. A.P. 1000cc. 0 to - 8 0 to + 2.

27.4.22 A.P. 1000cc. 0 to - 4 0 to + 6.

10.5.22. A.P. 1000 cc. - 4 to - 10 to Zero to + 2

9.6.22. A.P. 700 cc. 0 to - 5 to + 2 to - 3.

Lung well collapsed but patient still febrile. Disease in left lung showing considerable activity. Laryngeal condition not improved. Patient is cyanosed. Discharged at own request and has since died.

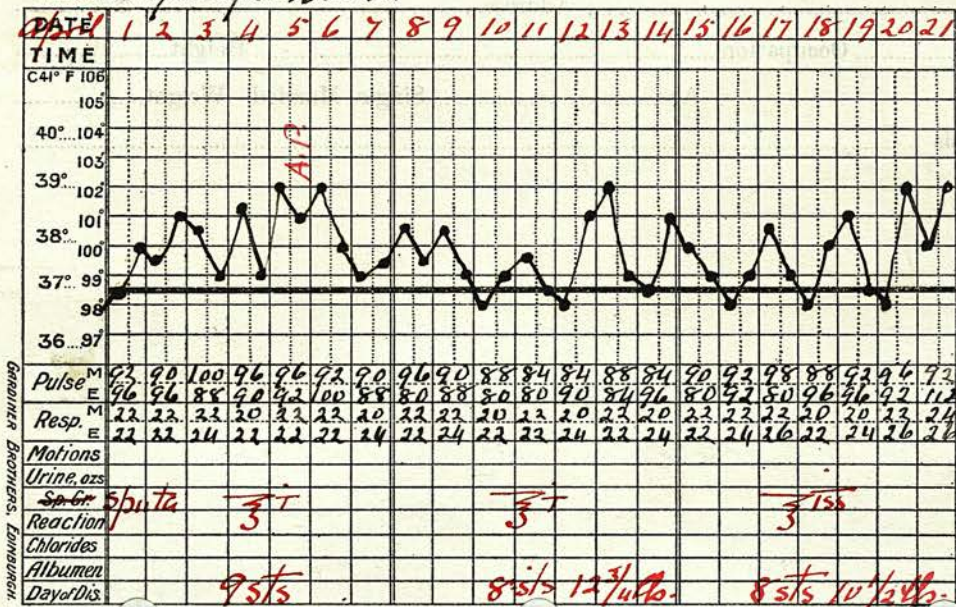


Case No. 11. G.W., male, age 42. Admitted 1.4.22.

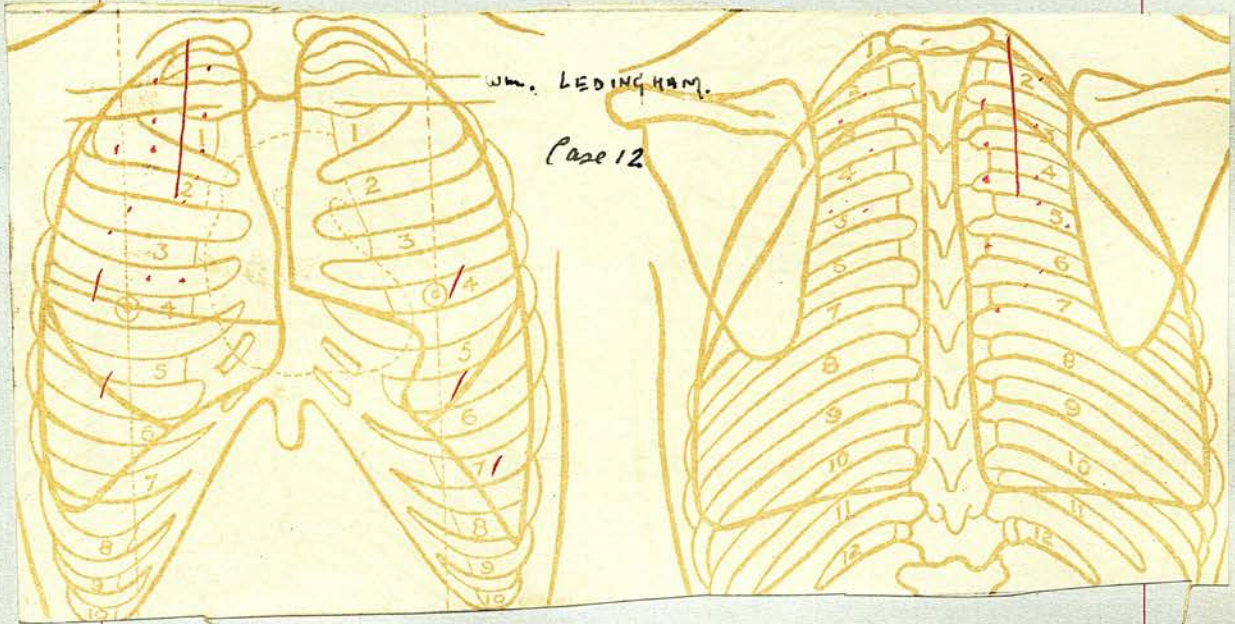
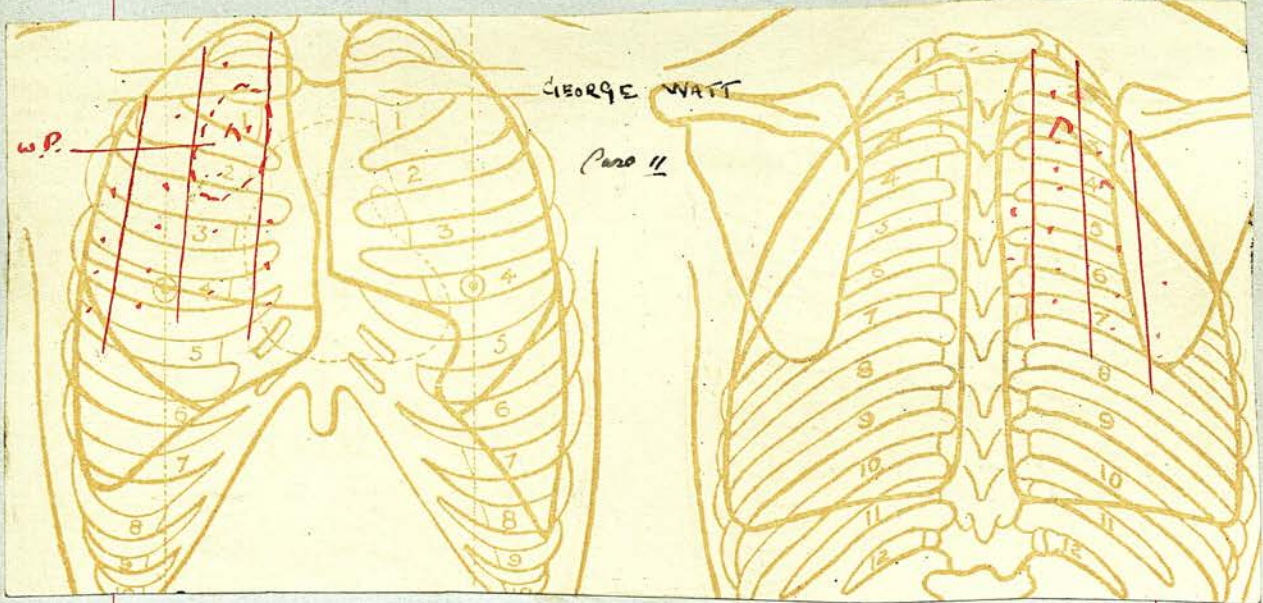
T.B. + . Febrile. Advanced right sided disease probably of long standing.

A.P. was attempted on three occasions at different sites but in no instance was sufficient amplitude obtained to justify one allowing any air to flow. Patient was allowed home at his own request. His subsequent history is unknown.

NAME Gange Watt.



GARDNER BROTHERS, DANBURGH.



Case No. 12. W.L., male, age 19. Admitted 17.5.22.

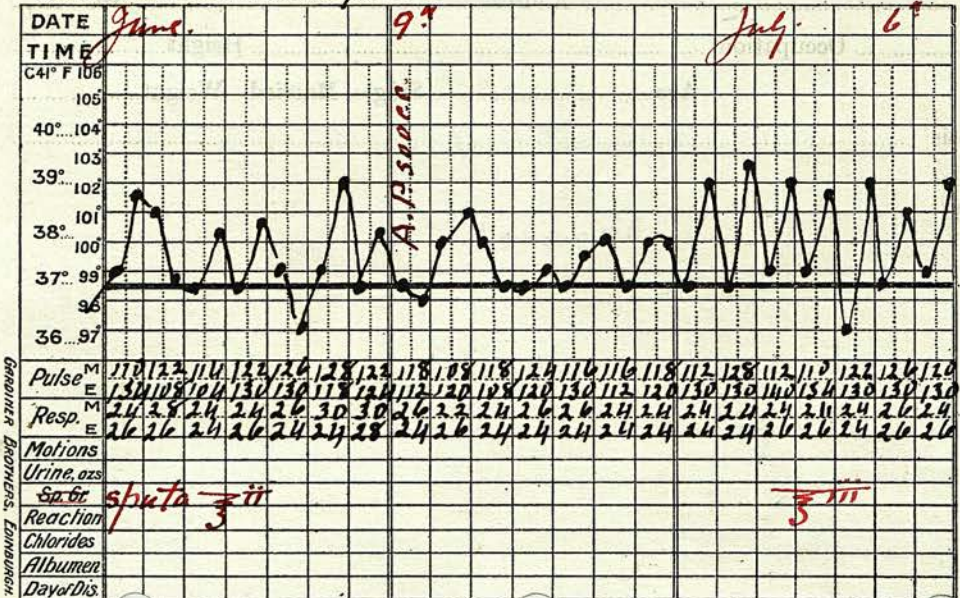
T.B. + . Sputum } III.

Most active disease on right side.

9.6.22. 500 cc. - 2 to - 10 to - 2 to - 2.

Shortly after this the disease in the left side of chest became very active and widespread and patient died on 15.8.22.

NAME W^m Ledingham



GANNON BROTHERS, LONDON

Case No. 13. C.W., male, age 19. Admitted 16.3.22.

Advanced left sided disease with occasional crepitation particularly at right apex.

4.4.22. A.P. 600 cc.

12.4.22. A.P. 900 cc. 0 to - 9 to 0 to + 6.

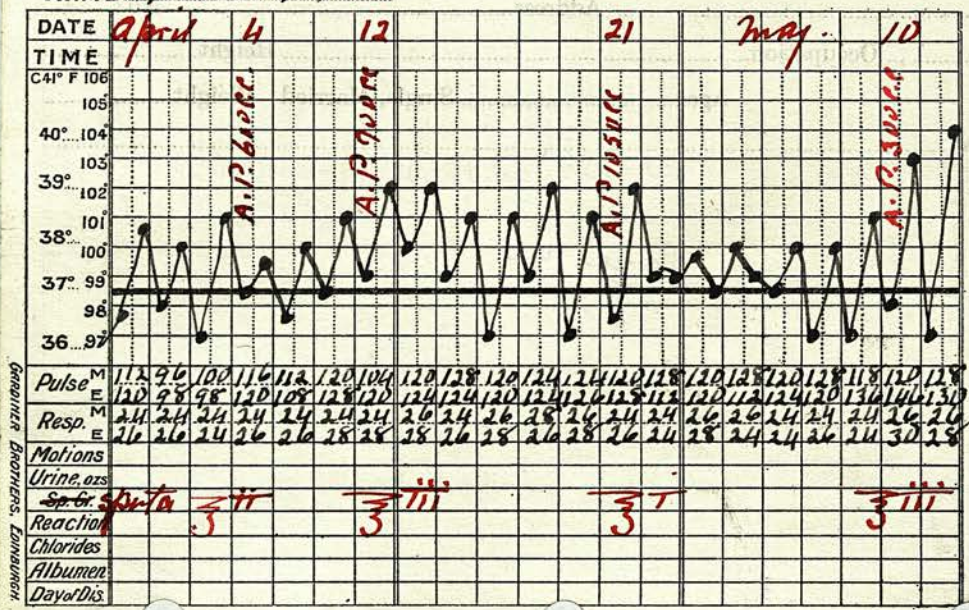
21.4.22. 1050 cc. 0 to - 8 0 to + 6.

10.5.22. 300 cc. 0 to - 2 0 to + 6

Disease still very active and much more advanced in right lung.

Patient died on 17.7.22.

NAME *Charles White*

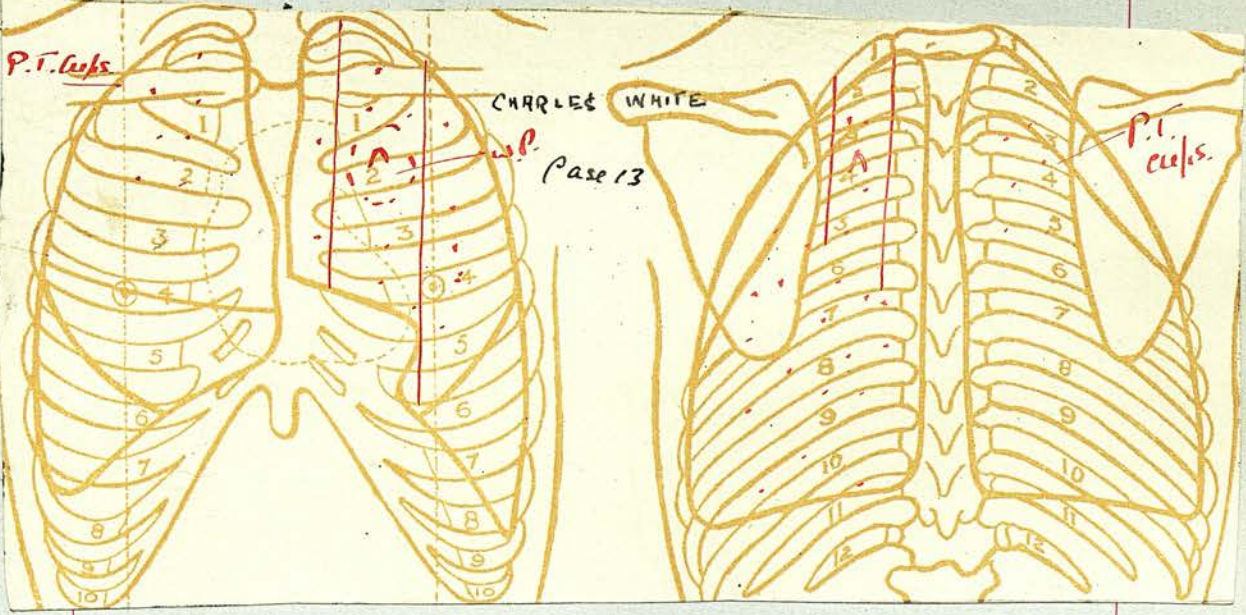


P.T. cups

CHARLES WHITE

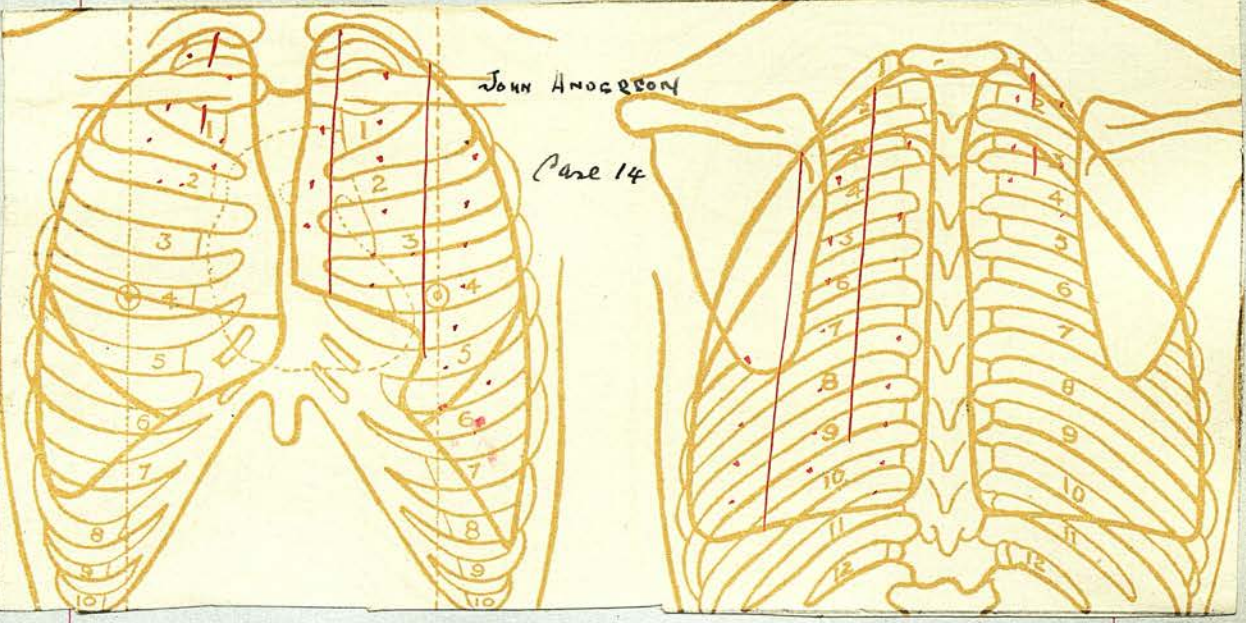
Case 13

P.T. cups



JOHN ANDERSON

Case 14



Case No.14. J.A., male, age 26. Admitted 1.7.22.

Widespread disease left side with
infiltration at right apex.

17.7.22. A.P. 650 cc. Zero to - 10. Zero to - 4.

3.8.22. No movement of Manometric fluid.

8-8-22 A. P. 540 cc.
23.8.22. 700 cc. - 2 to - 8. - 2 to + 2.

30.8.22. - 2 to - 6. - 2 to + 6.

Lung well collapsed but other lung showing increased activity so attempts discontinued at present.

Later it was decided to keep the left lung collapsed as there was a marked toxæmia.

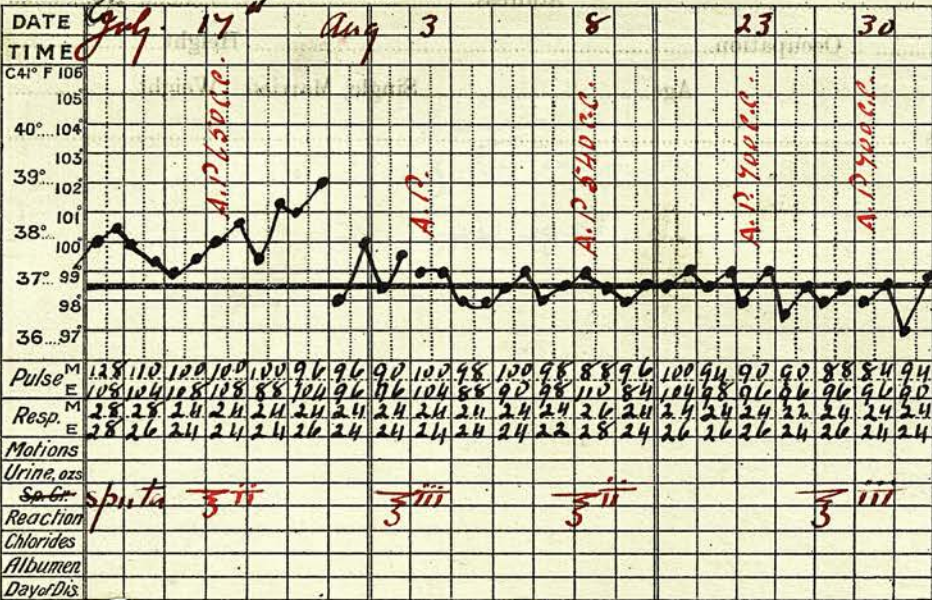
25.11.22. A.P. attempted. The Manometric response was scarcely sufficient: a little air was allowed to flow and a + pressure was recorded. Attempt discontinued.

29.11.22. Again attempted; puncture being made at another site. No fluctuation in manometer.

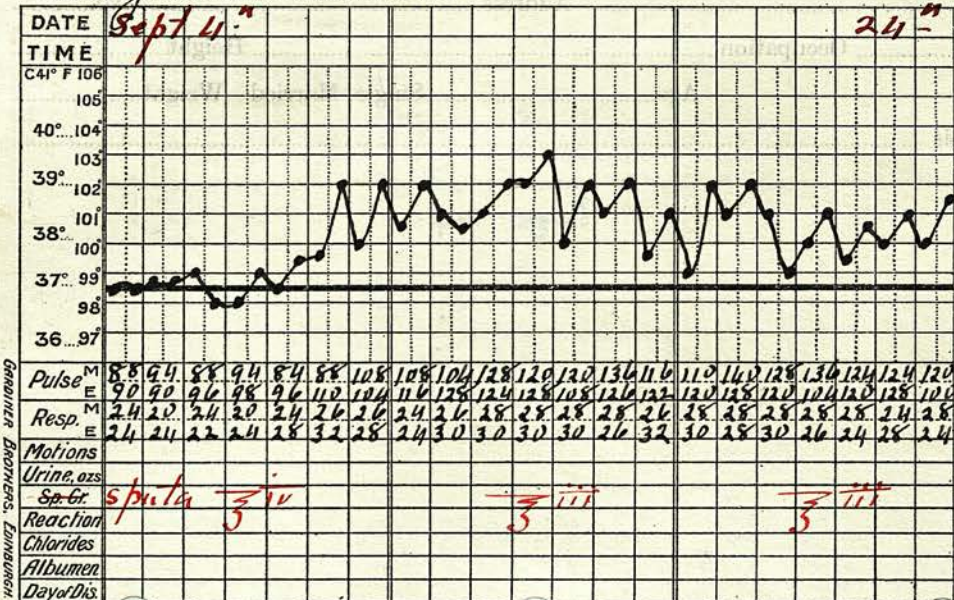
6.12.22. A.P. attempted. No amplitude.

The patient underwent a distressing febrile period with copious expectoration, but he has now somewhat improved. Temperature has remained normal for 5 days and his general condition has improved slightly.

NAME *John Anderson*



NAME *John Anderson*



Case No.15. A.D., male, age 21. Admitted 26.9.22.

Widespread disease on left side with impaired resonance and occasional crepitations right upper lobe.

10.10.22. A.P. attempted. No amplitude. Slight staining followed.

15.11.22. 500 cc. Zero to - 6. Zero to - 2.

20.11.22. 700 cc. - 2 to - 6 to + 2 to - 2.

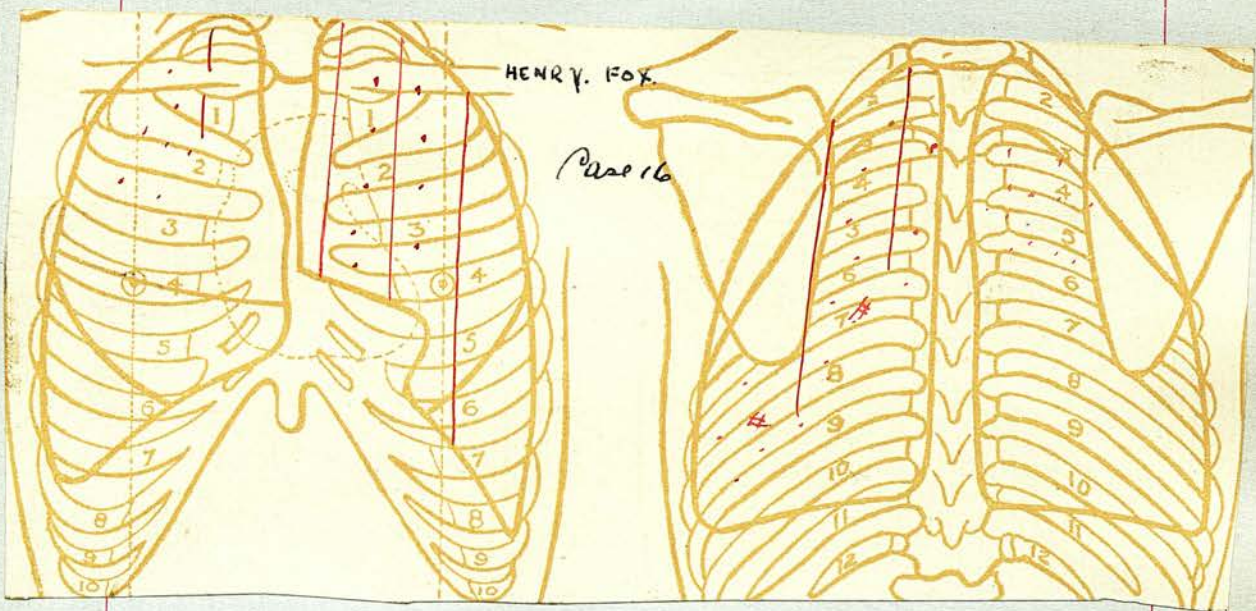
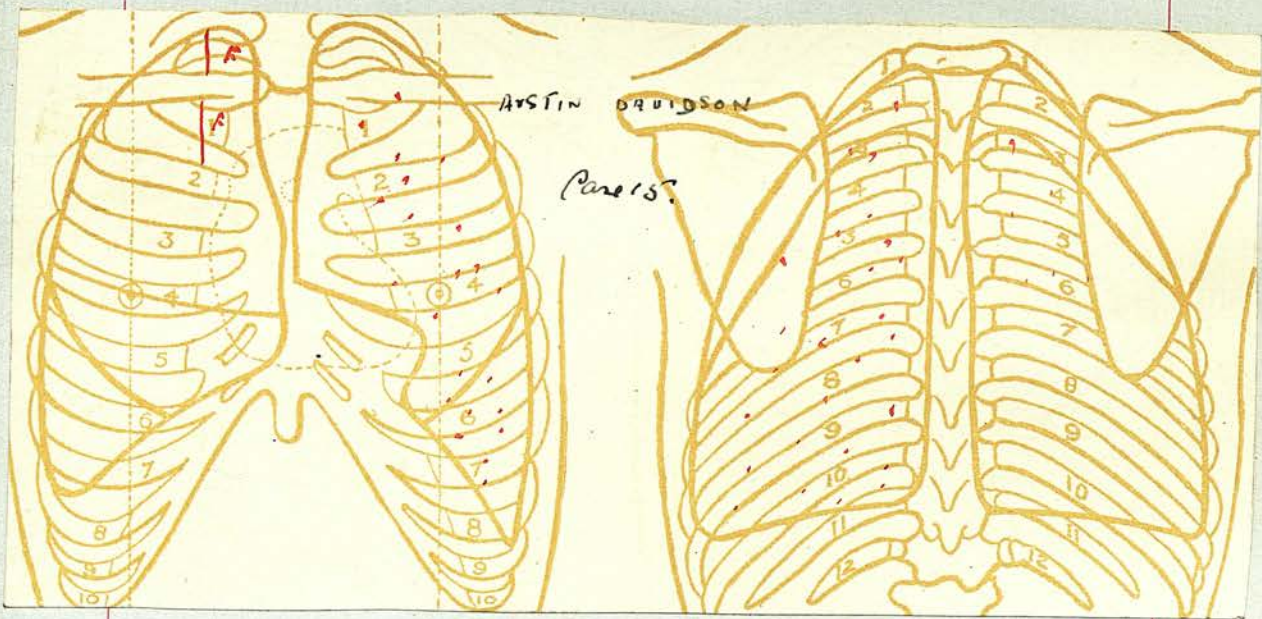
29.11.22. 1000 cc. Zero to - 8 to + 2 to + 4.

6.12.22. 700 cc. Zero to - 7. Zero to + 4.

Pain was complained of on the 28.12.22 and a spontaneous pneumothorax was found to have occurred completing the partial pneumothorax created artificially.

19.2.23. C.P. very good. Weight 10 st. 12 lbs.

Sputum 3I. T.B. + . Slight cyanosis: lung collapsed. Small amount of fluid at left base. Heart displaced. Apex beat at right side.



Case of Spontaneous Pneumothorax.

Case No. 16a. Mrs S.M. Admitted 24.3.22.

T. 97.6. Sputum 3^{ss}. T.B. - .

Weight 6 st. 13 lbs.

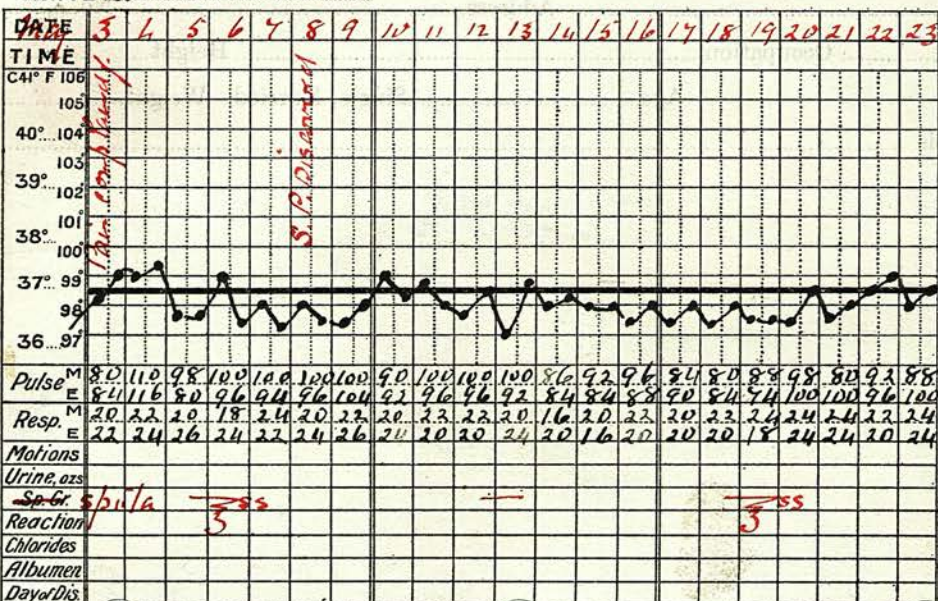
Pain complained of on 3rd May in left side.

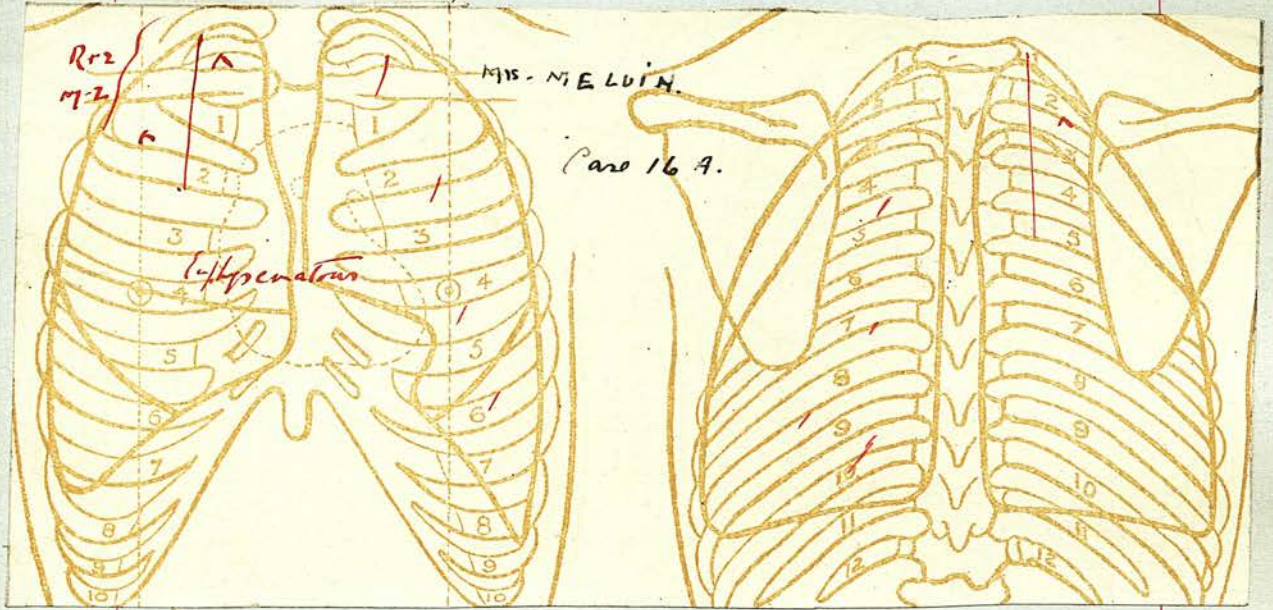
On examination a spontaneous pneumothorax had occurred with complete collapse of the lung.

As she was anxious to go home she was allowed to go on the 7th June 1922.

Weight 7 st. 6 lbs. Complete one sided pneumothorax still present. Slight Cyanosis. Apex beat displaced to right side. Sputum 3^{ss}. Non febrile. No signs of activity on leaving Hospital. Patient is still about and keeping well.

NAME M^{rs} Melvin

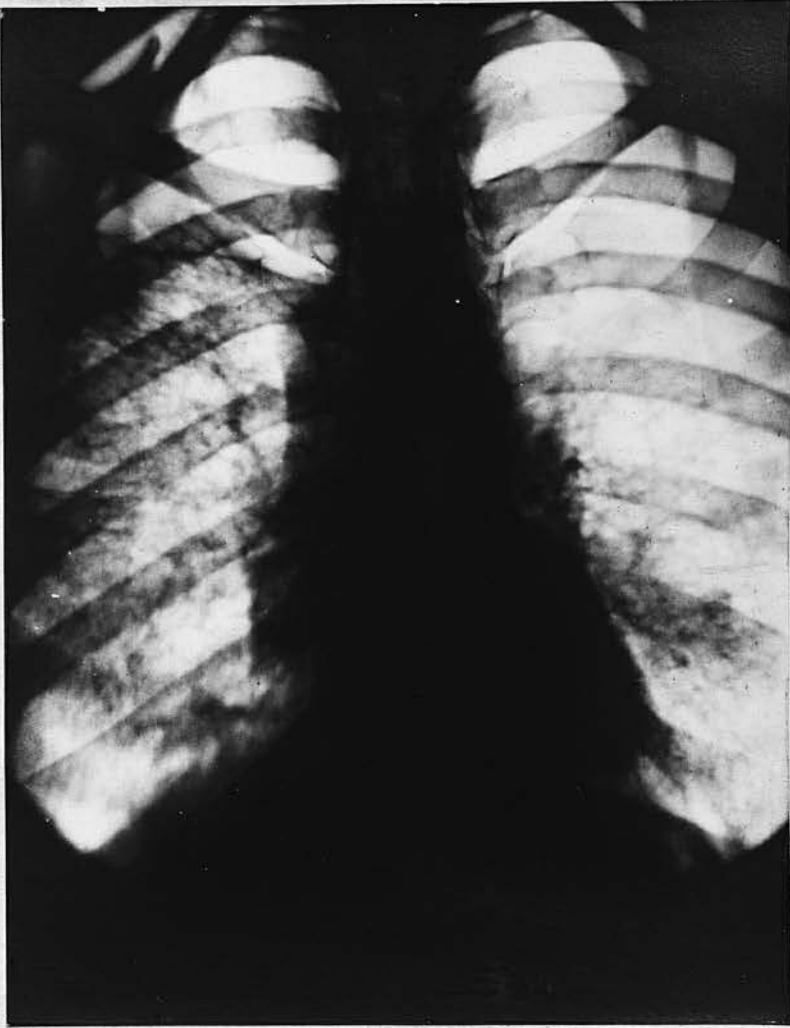






Case No. 16a. Mrs M.

Total collapse of left lung.
Heart pushed over to right side.



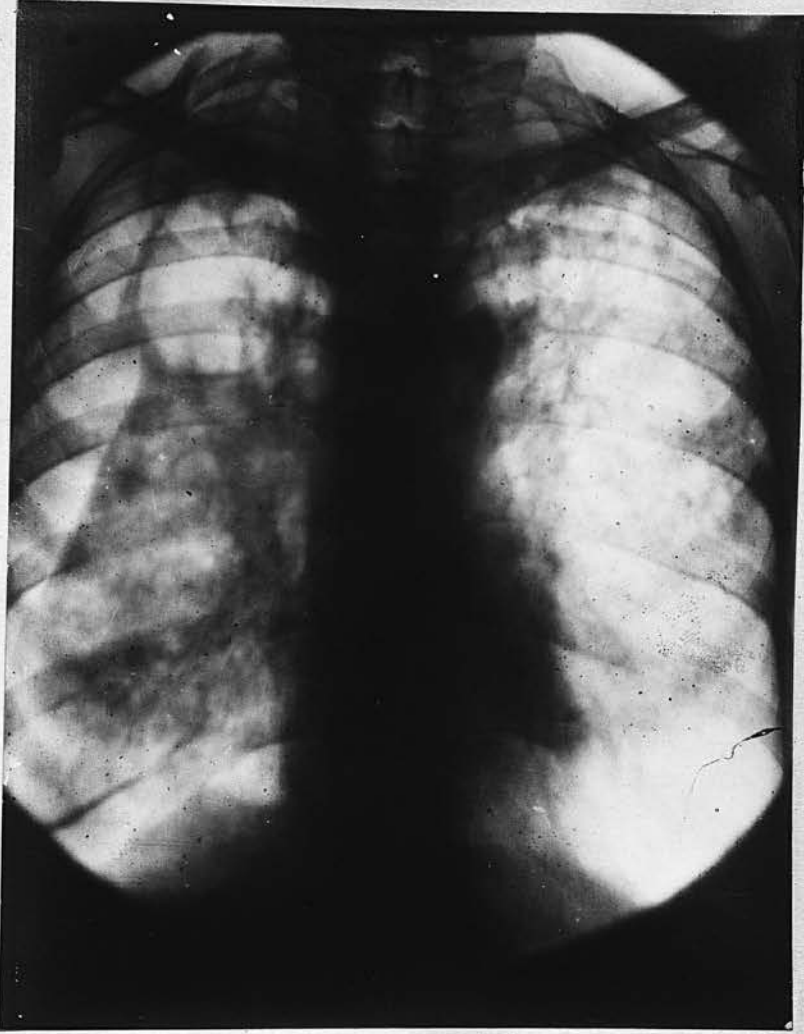
Case No.16a. Mrs M.

Left lung partially expanded.
Heart coming back to normal position.



Case No.16a. Mrs M.

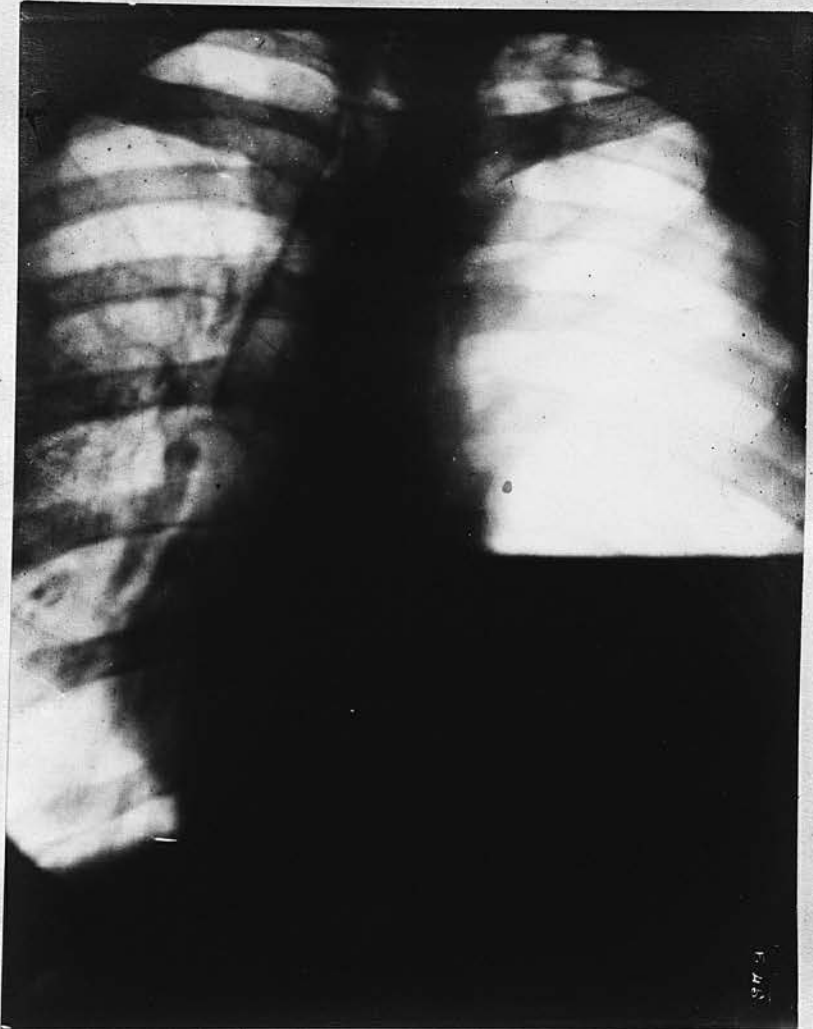
Heart returned to normal position.
Left lung expanded.



Case No.9. Mrs I.

Partial collapse of left lung.
Tuberculous infiltration of right lung.





Case No.15. Mr A.D.

Collapse of left lung with considerable quantity of pleural effusion.

A SUMMARY OF RESULTS OF VARIOUS WORKERS.

In our limited series of cases the results have been markedly disappointing. In only two out of sixteen cases could one say that the benefit that accrued was probably due to the operation. In these cases (2 and 15) the improvement was marked, the symptoms of acute disease disappearing and the patients being up and about, but unfit so far for any active employment.

In Case No.9, while the patient has not lost ground she cannot be truly said to be improved, her weight is the same as on admission: the cyanosis is still present and Tubercle Bacilli are present in the sputum. The disease in this case, while advanced on admission, showed no great activity; it was evidently a condition of long standing, so her condition appears to be neither better nor worse for the operation. Statistics from such a limited number of cases would be misleading but, palliative results could be said to have been obtained in $12\frac{1}{2}\%$ of cases. In this connection it is interesting to glance at the statistics published by other workers.

S. Vere Pearson¹⁵ in a report on 21 cases of Artificial Pneumothorax extending over 6 years states that of the 21, ten are dead, but of the others all excepting/

excepting one are enjoying fairly good health.

In another seven cases on which Artificial Pneumothorax was unsuccessfully attempted all save one are dead. This is an interesting comparison if it can be assumed that all had reached much the same stage of disease, but so many factors influence the prognosis that while it is interesting, the comparison can hardly be taken as proving very much.

Le Roy St Peter¹⁶ gives the following percentages but does not give the actual number of cases.

Arrested 31%. Improved 13%. Stationary 9%.

Progressive 3%. Dead 44%.

No indication is given of the time over which these cases were observed.

B. Sachs¹⁷ gives the results in 1145 cases.-

Failure	14.6%
Not Improved	18.6
Dead	16.2
Improved	29.2
Quiescent	10.8
Apparently arrested	9.4
Cured (sic)	1.4

Of the total number 6.2% were able to perform a certain amount of work.

Of/

Of 224 cases reported by Brauer, Spengles and Zink in which the patients were observed over periods extending from 6 months to 5 years, 42.9% were failures and the others showed some improvement or alleviation of symptoms.

18
Crockett in a report on 80 cases gives the following figures.-

Successful . . .	12
Partially successful	30
Failures . . .	38

By partially successful he means where alleviation of symptoms occurred but no return to working capacity.

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CONCLUSIONS.

From the statistics published by some workers it is claimed that a certain degree of benefit can be hoped for in about 50% of cases. Others are less sanguine and consider the usefulness of the method to be much more limited. They criticise the favourable results recorded by submitting that many of the cases have been lost sight of, while in others the observation has not extended over a sufficiently long period.

The results here have been by no means favourable, only two cases out of sixteen being benefitted and one remaining in the same condition as when admitted. All the others showed no benefit from the operation. In mitigation it may be said that in all cases excepting one, Artificial Pneumothorax was only attempted where the disease was very active, the patient was going rapidly downhill, and where no benefit had been obtained from other therapeutic measures.

Of the dangers and difficulties little need be said. They are by no means negligible but any treatment holding out a chance of stopping the march of this dread disease would be justifiable.

In only one of our cases was any actual harm done, and the end precipitated, and in that case the attempt was/

was made when the patient was very weak and with both lungs affected, not so much with the hope of arresting the disease but of alleviating symptoms. This of course is not taking into consideration the many cases in which active disease occurred in the other lung, and of which it may be argued that the Artificial Pneumothorax was the cause of the spread and increased activity.

The protracted course of treatment necessary is a distinct disadvantage as is the liability to pleural effusion and subsequent permanent collapse of the lung.

The conclusions arrived at are.-

- (1) That this method of treatment is applicable to only a very small proportion of cases.
- (2) That out of the number only half at the most will show any improvement.
- (3) It occasionally however gives some benefit when other therapeutic measures have failed.

While strictly limited in its application it is an adjunct of some value to other therapeutic measures but it is impossible to agree with Clive Riviere¹⁹ who says that "No more hopeful ray of sunshine has ever come to illumine the dark kingdoms of disease than that introduced in the path of the Consumptive through the discovery of Artificial pneumothorax".

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by Clive Riviere.
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