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F. Parkes Weber. With the author's compliments.

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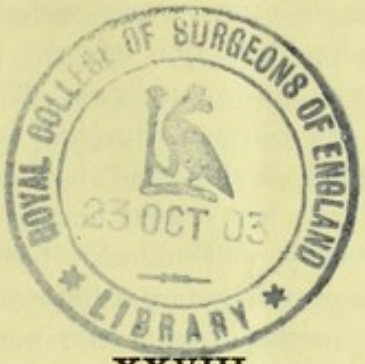

XXVIII.

The clinical forms of pneumothorax, especially pneumothorax in pulmonary tuberculosis and pneumothorax arising in apparently healthy persons.

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Physician to the German Hospital, London, Assistant Physician to the Mount Vernon Hospital for Diseases of the Chest.

In order to illustrate the occasional difficulty in explaining the origin of pneumothorax, I will first give an account of two cases under my care, in one of which recovery took place without any effusion of fluid into the pleura, whilst in the other an effusion of serum and pus occurred which had to be treated by operation.

Case I. The patient, G. B., was a piano-fitter, aged 31 years, without previous history of pleurisy, haemoptysis or pulmonary disease, and without any family history of consumption. In the absence of any violent strain or excitement, whilst doing his work on 21st November 1899, he suddenly felt a pain like a "knife sticking into him" on the left side of the chest. His breath gradually became shorter and the pain was very much increased by attempting to walk. On arriving soon afterwards at the hospital (German Hospital, Dalston) his respirations were about 30 and his pulse was about 65 in the minute. The movements were equal or nearly so on the two sides of the chest but no cardiac impulse could be felt; the cardiac dulness was displaced to the right of the sternum and there were distinct signes of pneumothorax of the left side. When the patient was kept quiet in bed, the dyspnœa and severe pain in the chest soon left him. No splash sound or metallic tinkling (other than what probably came from the stomach) was ever heard, and the signs of pneumothorax gradually disappeared in the course of 32 days. The first evidence of partial return to the natural condition was afforded by the absence of the bell-sound from the upper front part of the affected side of the chest. The most persistent of the abnormal signs was the displacement of the heart. During recovery from the pneumothorax the patient did not appear in any way ill. There was no expectoration, nor signs of pleurisy or pleuritic effusion of serum, blood or pus. From what I heard in June 1903 I gathered that the patient is still in his usual health. This case is a typical example of pneumothorax

arising without obvious exciting cause in an apparently healthy man, recovery taking place in the course of a few weeks without operative interference of any kind and without any liquid effusion into the pleura having been noted[1].)

Case 2. This case is still under my care. Mrs. E. A., a married woman, aged 28, was admitted to the German Hospital 14th November 1902. She had generally enjoyed good health, and had been confined five months previously. The last child was her second one; both children are living and healthy. She suckled the baby four months, but felt weak. She only felt really ill, however, a week or two before admission (cough, pains in back and chest, loss of flesh, etc.). In the hospital she was restless and feverish and I heard what I regarded as slight "pleuritic crepitation", but not a distinct friction sound, in the lower left axillary region. The onset of the pneumothorax was somewhat insidious, but it probably commenced on the night 22nd—23rd November, perhaps during sleep. Anyhow, the signs of pneumothorax on the left side were very well marked when I examined the patient on the morning of 24th November, though the left side of the chest seemed at that time to move with respiration almost as well as the right. The heart was displaced to the right of the sternum and the normal area of cardiac dulness was hyperresonant. The expiratory sound on the left side were amphoric, and there was a typical bell-sound (bruit d'airain), but no metallic tinkling or succussion splash. Pulse 128, respiration 44 in the minute (after the examination.) The fever continued, and about this time moderate albuminuria was noted.

The temperature, which during the latter part of November had several times risen to 104° F., remained below 100° F. after 10th December, and on 11th December the urine was found quite free from albumen. The signs of pneumothorax continued, and on 22nd December a distinct succussion splash was heard. Considerable fever from 17th January 1903 probably indicated the commencement of the change from a hydropneumothorax to a pyopneumothorax, and the patients general condition and strength deteriorated rapidly. On the morning of 27th January my surgical colleague, Dr. Michels, resected about $1^1/_2$ cm from the hinder part of the 7th rib to allow good drainage of the pus. The fever then gradually became less and the patient after a time began to gain ground slowly. At the commencement of March she was up and about in the ward, the heart was nearly in its normal position, and, though the bell-sound showed that the upper part of the pleural cavity still contained air, and though there was still a good deal of purulent discharge from the fistulous opening, the lung had evidently reexpanded to a considerable extent. Since then the general progress has been on the whole satisfactory. There is now hardly ever any fever, the patient is slowly but steadilty gaining weight, and the menses which were absent, recently returned. A little thin pus is, however, still (June 22nd 1903) discharged from the pleural cavity, and a

[1]) For more detailed notes of this case see Trans. Clinical Society of London, vol. 33, p. 171.

complete cure cannot unfortunately be expected for some time to come. General hygienic treatment is needed for a long period, especially good air, a nutritious diet and careful exercises. Though no tubercle bacilli have been detected in the sputum I think the pneumothorax was probably due to a slight tuberculous lesion. A typical general reaction followed the hypodermic injection of two milligrammes of Koch's old tuberculin.

Clinical classifications of cases of pneumothorax.

Clinically cases of pneumothorax may be grouped in several different ways.

(A) According to the presence or absence of liquid effusion and the nature of the liquid effusion when there is any, they may be divided into: — (a) simple ("dry") pneumothorax without any liquid effusion, (b) hæmopneumothorax, when there is an effusion of blood, (c) hydropneumothorax, when there is an effusion of serous or thin sero-purulent fluid, and (d) pyopneumothorax, when there is an effusion of pus. The simple pneumothorax (a) is often merely the first stage of a hydropneumothorax (c), which in its turn may become a pyopneumothorax (d).

(B) Another and better division is into: —(a) cases, like Case 1, of pneumothorax which remain simple "dry" pneumothorax until recovery takes place, that is cases which never become complicated by liquid effusion, or at least, in which no liquid is ever detected by the well known physical signs, and (b) cases which become complicated or are complicated from the onset with a liquid effusion in the pleura.

(C) An unsatisfactory clinical division is into:—(a) open (including valvular) pneumothorax, in which the opening by which the air entered the pleural cavity remains patent, and (b) closed pneumothorax, in which it has become closed. By physical signs (unless one resorts to aspiration) it is by no means always possible to say at once whether an opening through the lungs is still present or not, but when the lung of the affected side is found to be rapidly reexpanding, the opening must obviously have closed.

(D) Another division is into:—(a) cases of complete pneumothorax, and (b) cases of incomplete or localised pneumothorax, in which the extent of the entry of air into the pleura is limited by adhesions. Cases of tuberculous pneumothorax may be conveniently subdivided into these two groups.

(E) Cases may be divided into:— (a) those in which the onset of the pneumothorax is accompanied, as it usually is, by sudden and more or less distressing symptoms, and (b) those in which the onset is insidious and in which the pneumothorax may be said to remain for a time at least "latent". Especially may the onset be unaccompanied by the usual symptoms and physical signs[1]), when a pneumothorax is limited by adhesions and occurs on the worst side in a case of advanced pulmonary tuberculosis.

(F) Another division is into:—(a) cases of pneumothorax from without, when air is admitted by operations or wounds in the chest walls or diaphragm

[1]) Cf. remarks by Dr. H. M. Hughes, in the London Medical Gazette, 26th January 1844, p. 535.

or, extremely rarely, by ulceration from the exterior of the body, the stomach or the oesophagus; and (b) cases in which the air is admitted to the pleura from the lungs, or (very rarely) from the larger air passages.

(G) The clinical classification which I prefer is into:—(a) cases of pneumothorax obviously connected with pulmonary tuberculosis; (b) cases obviously due to other causes such as traumatism, empyema, etc; (c) cases arising in apparently healthy persons, some of which, however, are probably in reality due to slight and latent forms of tuberculosis. There must still remain some cases difficult to place, for instance, the second of the two cases described at the commencement of my paper.

Pneumothorax obviously connected with pulmonary tuberculosis.

In by far the majority of cases, perhaps 80 to 90 percent. of the total[1]), pneumothorax is due to pulmonary tuberculosis. It has been variously estimated as occurring in $3^1/_2$ to 10 per cent of all cases of phthisis. C. T. Williams[2]) even found that pneumothorax was present in 10 percent. of necropsies on consumptives.

Onset and symptoms. The physical signs will depend largely on whether the pneumothorax is complete or limited by pleuritic adhesions and, if the latter, on the position and extent of the adhesions. Adhesions in the front of the lung may check the displacement of the heart and mediastinum which constitutes one of the most important physical signs, if not actually the most important sign, in cases of complete pneumothorax. Moreover in cases of limited pneumothorax the onset is more likely to escape attention (latent pneumothorax), especially in weak patients already confined to bed, and when the pneumothorax is on the side most damaged by the tuberculosis, whereas when complete pneumothorax occurs in relatively vigorous patients and when the lung of the opposite side is already much diseased, the onset is generally marked by urgent distress, dyspnoea, sometimes faintness and often severe pain, especially on exertion or movement. The initial distress is likely to increase if the opening in the lung is very minute and acts as a valve, admitting air into the pleura during inspiration but not allowing it to escape during expiration. An important point (applying to all kinds of pneumothorax) is that one or more of the best known physical signs may be absent, at least at the time of examination. Thus amphoric breathing is very often (for a time at least) absent[3]), and frequently no breath sounds at all can be heard (silent pneumothorax); the "bell-sound" ("bruit d'airain") cannot always be obtained and (in some cases of early pneumothorax) the respiratory movements of the affected side of the chest may be almost equal to those of the sound side. Amongst the conditions which may be mistaken for limited pneumothorax is

[1]) See the remarks on Saussiers much quoted statistics by Dr. S. West, Diseases of the Organs of Respiration, 1902, vol. 2, p. 768.

[2]) C. J. B. and C. T. Williams, Pulmonary Consumption, Second edition, 1887, p. 206.

[3]) The presence or absence of amphoric breathing does not entirely depend on whether the pneumothorax is open or closed, that is whether there is a free opening or not through the lung (cf. S. West, loc. cit., p. 787).

subphrenic abscess due to perforation of the stomach or bowel, and this condition has even been named "subphrenic pyopneumothorax" (Leyden) or "false pneumothorax".

Course and Prognosis. In many cases the pneumothorax must be regarded as the terminal stage of the tuberculous disease. Occasionally patients die almost immediately after the onset. More frequently they survive the period of onset and in a few days the physical signs (succussion splash etc.) show that liquid as well as air is present in the pleural cavity. The liquid is generally serous at first (hydropneumothorax) but in most cases sooner or later becomes purulent (pyopneumothorax).

Even in bad cases the dyspnoea and distress usually present at the onset of the pneumothorax become much less marked in the course of a few days. The patients organism accommodates itself as best it can to the alteration in its respiratory mechanism so that a kind of compensation occurs. This accommodation of the organism to the new conditions may be especially marked in cases of relatively favourable prognosis when the distress at the onset of pneumothorax is very great, perhaps greater than in less favourable cases.

In by far the majority of cases the pneumothorax occurs when the changes in the lungs are already far advanced, but it may occur at any stage of pulmonary tuberculosis and may even be the result of a single tuberculous lesion. Thus S. West[1]) mentions the case of an elderly man who developed pneumothorax without urgent symptoms (latent pneumothorax) and who died of exhaustion; at the necropsy the pneumothorax was found to be due to the rupture of a small caseous cavity near the root of the right lung and no other disease was discovered in the whole body. Austin Flint[2]) recorded the case of a yong accountant aged 18 years who had suffered from hydropneumothorax of the left side for a good time before his death (his death was determined by pneumonia of the right lung). At the necropsy a little cavity was found in the left lung which had evidently led to the pneumothorax, for there were no other cavities or tuberculous masses. Letulle gives a case, to which I shall refer later, in which the lung contained only one tuberculous nodule, the rupture of which gave rise to the pneumothorax. Some of the cases of pneumothorax arising in apparently healthy persons to which I shall refer afterwards are probably due to slight tuberculous lesions.

In a few cases the pneumothorax has disappeared without any liquid being effused into the pleura.[3]) Surely however, in some at least of these cases the pneumothorax was not due to any actual tuberculous lesion, but rather to emphysematous changes associated with chronic or obsolete pulmonary tuberculosis, for instance to the tearing of a superficial bulla, perhaps connected by

[1]) Loc. cit. p. 807.

[2]) In an article on Pneumothorax in American Clinical Lectures 1876, vol. 1, p. 77. See also Andral's opinion on this subject, quoted by M. Naumann, Deutsche Klinik 1854, p. 298.

[3]) Vide S. West, loc. cit. p. 800, case 3. See also the examples collected by L. Galliard, Le Pneumothorax, p. 169.

an adhesion with the opposite pleural surface. Thus Dr. H. B. Whitney[1]) records a case of pneumothorax occurring suddenly in a man (aged 70 years!) who is supposed to have suffered formerly from pulmonary tuberculosis. On account of severe pressure symptoms the pneumothorax was tapped, and a cannula was left in the chest for several days. Complete recovery followed. A superficial emphysematous change or a pleuritic adhesion associated with chronic or obsolete tuberculous lesions affords the most reasonable explanation of the occurrence of pneumothorax in such a case. In support of this view Dittrich's case may be adduced.[2]) It is that of a doctor, aged 28 years, who had quiescent pulmonary tuberculosis and also emphysema. Whilst walking he was suddenly seized with fatal left-sided pneumothorax, which the postmortem examination showed to be caused by rupture of a sub-pleural bulla situated in a portion of the lung (the apex) showing cicatricial changes. Emphysema may indeed in certain cases be regarded as a connecting link between tuberculous lesions and pneumothorax, as was pointed out long ago by A. Brünnicke of Copenhagen.[3]) It is further to be remarked that in certain cases in which pneumothorax has appeared to be due to the rupture of an emphysema-bulla the emphysematous change has been found, not in the lower part of the lung, its favourite site in ordinary cases of emphysema, but in the upper part, at or near the apex, in which position it is often associated with obsolete tuberculous lesions or cicatrices from other causes.

In hydropneumothorax in tuberculous subjects cure has been known occasionally to occur with or without operative interference.[4]) I have quite recently heard of recovery from hydropneumothorax in a medical man with chronic pulmonary tuberculosis. It must be noted however that recovery from the pneumothorax may take place, though the patient die soon afterwards from progress of the tuberculous disease. Thus S. West[5]) records the case of a phthisical girl, aged 19 years, who developed pneumothorax of the left side and recovered from this complication in five weeks without any liquid effusion into the pleura having been detected; she died however a few months later from progress of the tuberculous disease. T. Bushby[6]) attended a phthsical gentleman about 44 years of age, who slowly recovered from an attack of right sided pneumothorax without liquid effusion, but who a few months afterwards became very weak from increase of the pulmonary tuberculosis. The patient was living when the account was given.)

The prognosis as to the patients ultimate prospects of life and partial or complete recovery of strength must depend on the extent of the tuberculous disease in his lungs, on his general condition, and, of course, on the local and

[1]) Philadelphia Med. Journal 1899, 14th January, p. 93, Case 2.

[2]) Dittrich's well-known case was first published by Dr. M. A. Wintrich in his "Krankheiten der Respirationsorgane", Erlangen 1854, p. 352.

[3]) English translation in Dublin Hospital Gazette 1856, vol. 3, p. 111.

[4]) See L. Galliard, Le Pneumothorax, p. 171.

[5]) Loc. cit. p. 800.

[6]) Liverpool Medico-Chirurgical Journal 1898, vol. 18, p. 198.

general treatment adopted. S. West gives relatively good results in a tuberculous case of pneumothorax with serous effusion treated by paracentesis[1]) and in one with seropurulent effusion treated by incision.[2])

Older writers have recorded cases of phthisical persons living a few years and able to enjoy life after the onset of pneumothorax. Thus, Dr. G. H. Barlow[3]) gave the case of a consumptive woman, aged 21 years, who lived at least three years after the onset of pneumothorax. Dr. H. M. Hughes[4]) narrated the case of a phthisical lady, aged 26 years, who developed hydropneumothorax on the right side and lived $2^1/_2$ years. He also mentioned[5]) the case of a young gentleman who lived over three years after the occurrence of pneumothorax, and who during a great portion of that time was in the habit of riding up from Lewisham to transact his business in London, and by agitating his body he used to produce a succussion sound for the amusement of his friends. There is no definite evidence however of the last case being one of pulmonary tuberculosis, though it probably was.

Leyden[6]) describes two cases of tuberculous pyopneumothorax in which a successful result was obtained by drainage with resection of part of a rib, aided by general treatment against the tuberculosis. One of these patients had already lived $2^1/_2$ years from the onset of the pneumothorax. Phthisical patients with pyopneumothorax (the effusion being at least turbid and seropurulent[7]) have, however, been known to live a considerable time, even years, though operative treatment was limited to paracentesis.[8])

Treatment. The question of treatment may be considered under measures to be adopted at the commencement of the pneumothorax and those which may become advisable later on. If the onset be accompanied by symptoms of collapse diffusible stimulants will be required. Sometimes special cardiac stimulants, such as digitalis or strophanthus, are given. In some cases sedatives, such as codeine or a small hypodermic injection of morphium, are indicated to relieve pain and excitement, but great caution must be exercised in regard to the dose as a decided narcotic effect may easily be harmful. Aperients may be serviceable to diminish the congestion of the portal system when pneumothorax occurs in relatively full-blooded individuals. The patient should not be unnecessarily moved about, as movements increase the dyspnoea

[1]) Loc. cit. p. 803, case 7.

[2]) Loc. cit. p. 821, Appendix.

[3]) Guy's Hospital Reports 1839, vol. 4, p. 339.

[4]) Guy's Hospital Reports 1853, vol. 8, p. 20. After death the right pleura was found to contain seropurulent liquid but no air.

[5]) Loc. cit. p. 3. No post-mortem examination is recorded in this case.

[6]) Proceedings of the "Verein für innere Medizin", Berlin, February and March 1890, Dtsch. med. Wchschr. 1890.

[7]) Cases of pneumothorax with thin sero-purulent effusion are sometimes termed hydropneumothorax and sometimes pyopneumothorax. This has led to some confusion.

[8]) Dr. F. R. Walters has kindly told me of a gentlemen recently under his care, who illustrated this point. See also Dehio's case described in the St. Petersburger Med. Wchschr. 1900, no. 25, p. 247.

and distress. Inhalation of oxygen may perhaps be of temporary use. If there is reason to believe that the distress is due to excessive tension of the pneumothorax the air may be allowed to escape by a cannula with an india-rubber tube attached, the end of which is allowed to hang down into a basin of sterilised water, or the air may be allowed to escape through a cannula into antiseptic dressings.

In some cases, as already stated, recovery from the pneumothorax may take place without any fluid being poured out into the pleura, but in most cases the presence of a succussion splash will soon show that the case has become one of hydropneumothorax or pyopneumothorax. The further treatment of cases of tuberculous hydropneumothorax and pyopneumothorax must to some extent depend on the general condition of the patient. In the "terminal" cases and when pulmonary tuberculosis is extremely advanced, a regular surgical operation can hardly be recommended but the fluid may be removed by paracentesis. In cases of pyopneumothorax without extensive pulmonary tuberculosis an operation like that for ordinary empyema is likely to give the most satisfactory results, though repeated paracentesis has often been practised. L. Galliard[1]) quotes illustrative cases of tuberculous pyopneumothorax in which surgical treatment (incision or resection of part of a rib) led to good results.

Hydropneumothorax, as already pointed out, does not always turn into pyopneumothorax, and has sometimes, like pneumothorax without liquid effusion, healed spontaneously. It is usually treated by paracentesis,[2]) but if the tuberculosis be not too advanced and repeated paracentesis fail, an operation like that for empyema and pyopneumothorax, may possibly, as Dr. West points out, be undertaken and lead to cure.

Whatever local treatment be adopted in these cases of hydropneumothorax and pyopneumothorax, every endeavour must be made to improve the patient's general condition,[3]) for it is upon the patient's general condition that the prognosis largely depends. The patient should have a generous diet, plenty of fresh air and all the advantages of the modern treatment of pulmonary tuberculosis (including climatic treatment according to special indications).

Pneumothorax obviously due to causes other than pulmonary tuberculosis.

Following are the causes other than pulmonary tuberculosis:

1. Wounds of the pleura (including those occurring during operations[4]) and other traumatic causes, such as fractured ribs. It is at first sight remarkable that pneumothorax does not occur much more frequently

[1]) "Le Pneumothorax", p. 186.

[2]) If a pneumothorax of any kind be aspirated, great care must be taken to aspirate very gently so as not to reopen the perforation in the lung which may have become closed.

[3]) Leyden (loc. cit.) in 1890 drew forcible attention to the great importance of combining general hygienic treatment with local treatment in such cases.

[4]) The presence of air in a portion of the pleural cavity resulting from operation in an ordinary case of empyema is not usually termed pneumothorax.

from such causes, but, as Dr. S. West has shown, the cohesive force between the opposed pleural surfaces is greater than the elastic contractile force of the lung. Moreover, if air be admitted to the pleura and the site of entry closed, the air will soon be absorbed and no harm will result, unless from shock or septic infection. The artificial admission into the pleural cavity of aseptic air or oxygen (as a substitute for some of the liquid drawn off) has even been advocated in the treatment of serous and purulent effusions.[1])

2. The bursting of an empyema through the lung. S. West[2]) points out that the reasons why air gains access to the pleura in such cases less frequently than might be excepted are: α) the defective movement of the side; β) the fact that the perforation is usually in the lower part of the lung and that the air enters the upper part of the lung more readily than the lower part; γ) the presence of what may be termed a fluid-valve in the channel of communication.

3. Destructive diseases of the lung, such as gangrene, abscess, septic embolic infarction, septic pneumonia and bronchopneumonia (in infants and children as well as adults), cancer and hydatids. Cases of pneumothorax and pyopneumothorax occurring during enteric fever[3]) may be due to localised septic suppuration or gangrene in the lung, or else to the bursting of an empyema.

4. Abscess, ulceration, cancer etc., in parts outside the pleura. These may in very exceptional cases cause the pleural cavity to communicate with the œsophagus,[4]) trachea, stomach, intestines, or exterior of the body.

5. Emphysema and violent respiratory efforts. It is not very easy to understand how an ordinary emphysematous bulla on the surface of the lung can be ruptured by respiratory efforts, unless it be adherent to the opposite pleural surface,[5]) yet it seems certainly to have occurred in some cases.[6]) S. West[7]) remarks that pneumothorax occurring as a complication in a case of ordinary pulmonary emphysema is almost unknown and he concludes that ordinary emphysema as a cause of pneumothorax may be practically disregarded, and that when during life this seems to be a possible interpretation, it is more

[1]) See Achard and Grenet, Soc. Méd. des Hôpitaux, Paris, April 1903. See also Potain, Des injections intra-pleurales d'air stérilisé dans le traitement des épanchements pleureux consécutifs au pneumothorax. Bull. de l'Académie de Médecine, Paris 1888, vol. 19, p. 537.

[2]) Loc. cit. p. 769.

[3]) See W. Hale White, Trans. Clin. Soc. London, vol. 29, p. 105; and W. Cayley, Trans. Clin. Soc. London, vol. 17, p. 52.

[4]) Pneumothorax is also stated to have followed rupture of the œsophagus from vomiting. See G. R. Turner's remarks, Trans. Med. Soc., London 1897, vol. 20, p. 121; also, Bowles and Turner, "Rupture of the œsophagus". Medico-Chirurgical Transactions, London 1900, vol. 83, p. 240.

[5]) Examples of pneumothorax due to the tearing of a superficial (subpleural) bulla fastened by an adhesion to the opposite pleural surface are to be found in F. W. Zahn's paper "Über die Entstehungsweise von Pneumothorax", Virchow's Archiv 1891, vol. 123, p. 197.

[6]) Compare necropsy findings in the case quoted by L. Galliard, Le Pneumothorax, p. 102 and p. 122, and in some of the cases in F. W. Zahn's paper in Virchow's Archiv, loc. cit.

[7]) Loc. cit. p. 770.

likely that the real cause is to be found in some other affection of the lung. In a case of fatal hæmopneumothorax described by G. Newton Pitt,[1]) the cause was apparently the rupture of an emphysema bulla near the apex of the right lung, but the bulla was adherent to the chest wall, and it seems to me that the existence of both the adhesion and the bulla in this case may very well have been due to a former minute tuberculous lesion. In regard to violent respiratory efforts as a cause of pneumothorax Dr. S. West[2]) points out that though the violent paroxysms of whooping-cough and the straining of parturition have given rise to pneumothorax, the condition commonly produced is not that of pneumothorax but of subcutaneous emphysema. Experiments by Champneys and by West show that over-distension gives rise to interstitial emphysema of the lungs, subpleural emphysema, mediastinal emphysema and subcutaneous emphysema, and that the pleura may be ruptured in such experiments so as so produce pneumothorax. Yet in most cases, according to West, the lungs can resist the highest pressure which expiratory efforts can bring to bear on them, so that, when they rupture, the question arises whether the absence of a local lesion may be assumed. These questions have an import bearing on the subject of pneumothorax arising in apparently healthy persons, which I have presently to consider.

6. Gas given off from an effusion of blood or from decomposing material in the pleura. This must be one of the rarest causes of pneumothorax during life. Decomposition (Bacillus capsulatus aërogenes, B. coli, etc.) giving rise to gas in the pleural cavity is more likely to occur after the death of the patient, and in the rare cases of pneumothorax from gangrene of the lung a perforation in the lung has probably been the cause. In some cases of hæmopneumothorax the air in the pleura has been supposed to have been given off by the effused blood. The possibility of this explanation is considered in a fatal case described by H. D. Rolleston,[3]) in which no rupture of the lung could be found.

I shall not enter into the course and treatment of these rare cases of pneumothorax, pyopneumothorax and hæmopneumothorax. Much will depend on the general condition of the patient and on whether a serous, sero-purulent or purulent effusion accompanies the pneumothorax. The questions arising are largely surgical, including treatment of fractured ribs and injuries to the chest wall, operation on empyema, etc.

Pneumothorax arising in apparently health persons.

I shall consider this class at somewhat greater length than the preceding, firstly, because though the cases are rare I believe they are less rare than is commonly supposed, secondly, because the recognition of their ordinary course and of their usual tendency to complete and spontaneous recovery is most important in regard to both prognosis and treatment.

[1]) Transactions Clinical Society, London, vol. 33, p. 95. Compare some of the cases given by Zahn, loc. cit.

[2]) Loc. cit. p. 770.

[3]) Transactions Clinical Society of London, vol. 33, p. 90.

At least sixty or seventy cases of pneumothorax arising in apparently healthy or nearly healthy persons could be collected from medical literature and there are other cases which have not been published. Many cases have been described in England. Dr. S. West[1]) and Dr. F. de Havilland Hall[2]) have tabulated series of cases and the subject has been discussed by L. Galliard[3]) in France. More recently larger collections have been analysed by M. H. Fussell and D. Riesman,[4]) in America, and by H. Maillart and A. Lasserre,[5]) in Switzerland.

I find no advantage in labelling such cases "idiopathic pneumothorax" or "spontaneous non-tuberculous pneumothorax" (Fussell and Riesman); it is far better, I think, to group them together as cases of pneumothorax arising in healthy or nearly healthy persons, for, as recovery practically always takes place, their exact aetiology is generally a matter of conjecture. The air entry has been variouly ascribed to the rupture of minute tuberculous lesions (subserous tubercles), the bursting of subpleural emphysema-bullæ, and the tearing of air cells close to pleuritic adhesions. Each of these explanations is probably sometimes correct, but I shall now specially consider the first one.

In several of the cases there have been slight hæmoptysis and signs suggestive of small tuberculous lesions in the lungs and family history of consumption.[6]) Certain cases have shown that occasionally the lung may re-expand spontaneously and the pneumothorax be recovered from, even in severe forms of phthisis and one or two cases have been recorded in which a single tuberculous lesion in a lung has led to pneumothorax.[7]) Then, again, necropsy experience shows that minute tuberculous lesions in the lungs may exist without giving rise to physical signs, and also, as is well known, that spontaneous recovery from such tuberculous lesions may take place without special attention ever having been directed to the lungs. Moreover, the fact pointed out by T. Whipham and F. de Havilland Hall that the age of most patients is under thirty may likewise be put forward in favour of the probability of a tuberculous lesion being the cause of the pneumothorax. At the necropsy on Newton Pitt's case (already referred to) of fatal hæmopneumothorax no perforations or injuries could be found, nor was there any trace of inflammatory, necrotic or distinctly tuberculous lesion in the lung, but there was an emphysematous bulla, about half an inch in size, torn open, situated near the apex of the lung; and attached to this was a ruptured adhesion, from which the blood might have come. It seems to me that both the adhesion and the bulla

[1]) Transactions Clinical Society of London, 1884, vol. 17, p. 56.

[2]) Transactions Clinical Society of London, 1887, vol. 20, p. 153.

[3]) "Du pneumothorax simple, sans liquide, et de sa curabilté", Archives gén. de Médecine, 1888, vol. 161, p. 275; also "Le Pneumothorax", Paris, Bibliothèque Charcot-Debove.

[4]) American Journal Medical Sciences, August 1902, p. 208.

[5]) Rev. Méd. de la Suisse Romande, 20th November 1902, p. 745, to 765.

[6]) C. J. B. and C. T. Williams (loc. cit. p. 213, cases 41 to 44) give 4 cases of recovery from pneumothorax with little or no liquid effusion and without any operative interference, all in patients in whom a tuberculous origin of the pneumothorax might be suspected.

[7]) These cases have been already referred to.

may very well in this case have been the result of a former minute tuberculous lesion which had healed, and the same suggestion in justified in certain recorded cases of pneumothorax in which a post-mortem examination has shown the pneumothorax to have arisen from the rupture of a superficial emphysema bulla connected by an adhesion with the opposite pleural surface. Letulle[1]) reports the case of a man, who though he apparently had nothing the matter with him except diabetes, was attacked by pneumothorax and died suddenly eight days afterwards. The necropsy showed that the lung contained only one tuberculous nodule, the rupture of which had given rise to the pneumothorax. On the whole, I am decidedly in favour of the view that a fair proportion of these cases of pneumothorax arising in apparently healthy individuals are in reality due to tuberculosis.[2])

Rupture of a superficial bulla due to slight pulmonary emphysema is probably the cause in a certain number of cases, but W. H. Ranking's case,[3]) one of those most often quoted in support of this view, requires special consideration. A young man, aged 19 years, while at church, was suddenly seized with the symptoms of left-sided pneumothorax. The pneumothorax was gradually recovered from within two months, but later on the patient died suddenly from the effects of a dissecting aneurism of the aorta. At the necropsy the lungs were found free from tubercles but there were some dilated air-cells especially near the apex of the left lung. It must be remembered that emphysema-bullæ near the apex of the lung in young persons are very often connected with older cicatricial changes. Moreover, certain other cases suggest that when pneumothorax appears to be due to rupture of subpleural bullæ near the apex of the lung, the condition leading to the pneumothorax is not one of ordinary emphysema but one of emphysema connected with obsolete tuberculous lesions or with cicatricial changes from other causes.

Onset. In the majority of cases there has been no obvious or adequate exciting cause, and in the first case of Fussell and Riesman,[4]) in Landmann's case[5]) and M. Heitler's case[6]) the onset was during sleep, but sometimes the symptoms have followed some exertion or sudden movement. Thus the onset has been ascribed to dancing,[7]) jumping,[8]) pulling on a boot,[9]) lifting

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[1]) Soc. Méd. des Hôpitaux, Paris, June 1901.

[2]) I doubt, however, whether the diagnostic use of tuberculin will settle the question, since the tuberculous lesions must be very slight.

[3]) British Medical Journal 1860, p. 665.

[4]) Loc. cit. p. 220. The patient was a young woman, aet. 21, in apparent health at the time.

[5]) Münchener med. Wochenschrift 1903, Nr. 8, p. 354. A man, aet. 26, appearing healthy before the onset.

[6]) Wiener med. Wochenschrift 1879, Nr. 17, p. 461.

[7]) Biermer's case, Würzburger med. Zeitschrift 1860, vol. 1, p. 384, a man aged 19.

[8]) W. A. E. Waller, Lancet 1890, vol. 1, p. 292. Very insidious onset in a young man, aet. 16, after jumping.

[9]) Maillart and Lasserre, loc. cit. p. 745. A man, aet. 28.

up a child,[1]) blowing a trumpet,[2]) shouting,[3]) violent laughing,[4]) coughing,[5]) sneezing,[6]) vomiting[7]) (?), and coitus.[8])

In a case kindly narrated to me by Dr. G. Hamilton an apparently healthy man was helping to lift a sideboard at the time when the symptoms commenced.

The physical signs are of course much the same as when complete pneumothorax occurs in phthisical patients. It is however worth while mentioning that metallic tinkling may be present in these cases, when there is almost certainly no liquid effusion in the pleura;[9]) metallic tinkling from the stomach has specially to be thought of in pneumothorax of the left side. The symptoms at the commencement may be very distressing, but often are not, and the severity varies much in different cases. The onset is occasionally very insidious, almost latent. Symptoms are of course much increased when the patient in any way exerts himself (climbing up stairs) or is suddenly moved (driven in a jolting vehicle). My patient (case 1) said that the pain was increased on his attempting to walk and also by the jolting of the cab when he was being brought to the hospital. In G. Jochmann's case[10]) the onset was completely latent. The patient, a well-nourished man, aged 22 years, walked on foot to the hospital, and had no dyspnœa or tachycardia, though he presented the typical physical signs of complete pneumothorax on the right side. In the case of which Dr. G. Hamilton told me, the patient, a medical man, aged about 30, in apparent health, was seized by a sharp pain in the side on helping to hold up a sideboard. The pain soon went off spontaneously, but he was surprised by breathlessness on climbing up stairs, breathlessness to which he had not previously been subject. Yet in spite of dyspnœa on exertion he was

[1]) L. Galliard, Archives gén. de Médecine, Paris 1888, vol. 161, p. 286.

[2]) V. Widal (quoted by Galliard, Le Pneumothorax, p. 113) gives the case of a trumpeter who was seized with pneumothorax whilst blowing his trumpet. As the pneumothorax was followed by fatal pyopneumothorax the case may have been due to some lesion which escaped notice at the post mortem examination, and not merely to the rupture of a superficial bulla of ordinary pulmonary emphysema.

[3]) Though G. Klemperer's patient was a man (aet. 21) whose business it was to go shouting and selling his goods through the streets it is not stated in the account (Deutsche med. Wochenschrift 1893, Nr. 25, p. 602) that he was shouting at the precise moment when the symptoms suddenly occurred.

[4]) J. Levison, Münchener med. Wochenschrift 1899, Nr. 41, p. 1341; also B. G. Mac Dowel, Dublin Hospital Gazette 1856, vol. 3, p. 227.

[5]) T. Bushby, Liverpool Medico-Chirurgical Journal 1898, vol. 18, p. 199, second case; also Fussell and Riesman, loc. cit., second case.

[6]) B. Stiller, Wiener med. Wochenschrift 1901, Nr. 18, p. 857.

[7]) This has been mentioned as a cause, but I can find no published examples in which vomiting has been the exciting cause of pneumothorax except the cases of rupture of the œsophagus already alluded to in a footnote.

[8]) A. Renault's case in a man, aged 46 years, quoted by L. Galliard, Archives gén. de Médecine, Paris 1888, vol. 161, p. 284.

[9]) Vide F. de Havilland Hall (loc. cit.) and J. M. Finny (Dublin Journal Medical Science, 1898, vol. 105, p. 273).

[10]) Zeitschrift für klin. Medizin 1902, vol. 45, p. 97.

able to do his medical work, making his ordinary rounds, until a fellow practitioner who examined him two days later made the diagnosis of complete pneumothorax. Complete cure followed a rest of two weeks or so in bed.

Course and prognosis. In nearly all cases, even in those in which owing to symptoms of excessive pressure (valvular action of the opening in the lung) paracentesis had to be performed to let some of the air out, the initial distress was soon recovered from on resting. The abnormal physical signs generally last some weeks. In my case they disappeared in about 32 days, and 4 or 5 weeks is probably about the average duration. All subjective symptoms may however disappear much earlier so that it has been found very difficult, and sometimes quite impossible, to keep the patient quiet and prevent him from resuming his ordinary work too soon. In Jochmann's case (already referred to) a relapse occurred when the patient commenced work again, but after re-admission to the hospital he quite recovered.

In some cases however the duration of the pneumothorax has been much longer than the average, and Dr. H. B. Whitney[1]) examined a woman, aged 35 years, who had the signs of simple ("dry") pneumothorax of the left side, which apparently arose suddenly nine years previously whilst she was walking up a hill.

In most cases the pneumothorax has remained simple, recovery having occurred without any liquid being detected in the pleura. In some cases however a certain amount of liquid has been effused,[2]) which has been absorbed spontaneously or after paracentesis.[3])

In a few cases the Roentgen rays have been used to confirm the diagnosis and watch the progress of recovery, but I cannot believe that their help can often be really necessary, and nothing can make a diagnosis which is already certain more certain still.

In quite a considerable proportion of the cases a recurrence of pneumothorax has taken place after a longer or shorter interval. Thus, my father, Sir Hermann Weber, tells me he remembers an otherwise healthy, stout, man, about 32 years of age, who on two separate occasions, with about two years interval between the attacks, developed pneumothorax, recovery on each occasion taking place within a few weeks. Dr. J. F. Goodhart[4]) has recorded

[1]) Philadelphia Med. Journal, 14th January 1899, p. 92, case 1. In this connection, moreover, the remarkable case of Dr. J. F. A. Adams may be quoted (Boston Medical and Surgical Journal 1886, 28th Oct., p. 397). It is that of a man who up to the age of 44 years enjoyed good health, but who then, after about 3 days illness (supposed to be pleuro-pneumonia of the left side), suddenly became dyspnœic, whilst straining at stool. The dispnœa continued and was probably due to pneumothorax of the left side, which, however, was not actually detected till two years later. The pneumothorax disappeared spontaneously after apparently lasting 5 years without any effusion of liquid into the pleura having ever been detected.

[2]) S. West, Diseases of the organs of respiration, 1902, p. 802—805, cases 6 and 8; in case 9 the patient left the hospital with serous effusion, but no air, in his pleura. See also cases of Maillart and Lasserre (loc. cit.), of Landmann (loc. cit.), and of Biermer (loc. cit.).

[3]) S. West, loc. cit., case 6. In this case sero-purulent fluid was withdrawn.

[4]) Transactions Clinical Society of London, 1896, vol. 29, p. 109.

the case of a young man, aged 24 years, who suffered from pneumothorax, first on the right side and a year later on the left side, the effused air being fairly rapidly reabsorbed on both occasions without giving signs of pleuritic disturbance. Austin Flint[1]) gives the account of an emphysematous pedlar, aged 29, who twice had pneumothorax after great exertion and on both occasions recovered with rest. S. West[2]) speaks of a man, aged 22 years, who recovered from pneumothorax (probably his third attack) without any effusion of liquid. West[3]) also gives the case of a healthy-looking man, aged 21 years, who recovered from pneumothorax with liquid effusion on the left side (without paracentesis), and six months later suffered from pneumothorax of the right side without liquid effusion, and then got well again. D. H. Gabb[4]) gives the case of a lady, aged 56 years, who had apparently had 4 separate attacks of pneumothorax, each on the right side and ending in recovery.

When an attack of pneumothorax follows very soon on another one on the same side[5]) from which recovery has apparently taken place, it is probable that the "recurrence" ought to be regarded rather as a relapse of the original attack, the aperture in the lung having re-opened, possibly on account of premature exertion on the part of the patient.

Treatment. Urgent symptoms at the onset demand similar treatment to that required for urgent symptoms at the onset in phthisical cases. It is best not to tap the pneumothorax unless the signs (dyspnœa, cyanosis etc.) point strongly to excessive pressure, and it is quite possible that the proportion of cases in which a valvular action of the opening through the lung gives rise to excessive pressure has been overestimated. Septic infection of the pneumothorax by too hasty and careless use of instruments is, needless to say, one of the worst complications which can occur. In most cases the pneumothorax remains simple ("dry"), and, if a little serous fluid be effused, it is generally[6]) spontaneously absorbed. In most cases all that is required is to keep the patient at rest. He usually soon thinks that he is nearly well again, but if he begins work too early, a relapse is to be feared.

When in cases of pneumothorax in apparently healthy persons a tuberculous origin of the pneumothorax is suspected, the prognosis as to ultimate results should be somewhat guarded, that is to say, the patient should be advised to maintain his general health by the methods (sufficient food, exercise in the open air, and as far as possible an open air occupation) ordinarily recommended for persons supposed to be predisposed to phthisis.

[1]) Principles and Practice of Medicine, Sixth edition 1886, p. 148.

[2]) Diseases of the organs of respiration, 1902, p. 801, case 4.

[3]) Loc. cit. p. 805, case 8.

[4]) British Med. Journal 1888, vol. 2, p. 178.

[5]) Cf. Jochmann's case already quoted. In Dr. J. M. Finny's case (Dublin Journ. Med. Sci. 1898, vol. 105, p. 273) the patient, a stableman, aet. 18, suffered from a second attack on the same (left) side only a fortnight after leaving the hospital. He was doing heavy lifting work with a manure fork at the time.

[6]) In Ferrari's case (a boy aged 16, Gazette Méd. de Paris 1856, p. 163) a trocar was introduced, apparently not because of the slight serous effusion, but only to draw off air.