Oct. 13 1917

From the Regius Professor of Medicine, Oxford.

13 Norham Gardens
October 13th.

Dear Pepper,

Congratulations on your Pneumo-thorax paper! It is a great pleasure to see your name in the American [of the American Physician] Journal, to which your father and grandfather were such distinguished contributors. Love to your mother and Will.

Sincerely yours,

W Osler

I thought you were coming over this year

The Insidious Onset of Pneumothorax.

BY

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THE INSIDIOUS ONSET OF PNEUMOTHORAX.[1]

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It is unnecessary to attempt to enter here into a detailed description of pneumothorax, its etiology, symptoms, or treatment. This condition is so well known nowadays, and its recognition, despite its protean symptomatology, so well established by the enormous amount of work and the multitudinous articles on this subject, that anything further seems superfluous. There is, however, a certain type of case in which pneumothorax seems to be quite frequently overlooked. I refer to those instances in which the pneumothorax develops insidiously, without the classical signs of sudden pain and intense dyspnea. A pneumothorax developing slowly or silently without symptoms tends to escape notice, and especially if it occurs in an apparently healthy individual, or, less excusably, in the presence of active pulmonary tuberculosis, the signs of which may obscure the findings. Furthermore, the very type of pneumothorax which is most difficult to detect is also most liable to develop insidiously. It is obvious that a small circumscribed partial pneumothorax will not only give less clear physical signs, but also fewer symptoms. It is the insidious development of pneumothorax that I wish especially to emphasize, and I have chosen such cases to report as I hope will illustrate this.

The first case to be reported is from Dr. Alfred Stengel's service at the University Hospital:

Case I.—M. R., white, male, aged twenty-three years, car conductor, was admitted on December 1, 1903 with the following history: Present illness began last winter, with a "heavy cold" in chest. Patient had only cough and general weakness, but was compelled to give up work at intervals of a few days or weeks, until about three months ago, when he had to give up entirely. He had slight pain in chest at times, but it was not a prominent symptom. Dyspnea had been the worst symptom for about three months. He had lost about twenty pounds in weight since last winter. At times he expectorates large amounts of sputum, but usually very little. In the summer of 1903 he had on several occasions hemoptysis, at times quite profuse and again slight.

On admission his complaints were cough, weakness, pains in left chest, and dyspnea. Temperature, 99°; pulse, 105; respirations, 26.

[1] Read before the Section on General Medicine of the College of Physicians, April 24, 1911.

The physical examination of his thorax is recorded as follows: "Left shoulder carried higher than the right. Chest seems flattened. Left side seems larger than right, and measurement shows a difference of nearly 1 inch, the right measuring 16½ inches and the left 17½ inches just above the nipples. Expansion greater on right; the left side expands very slightly, if at all. No fremitus on left side. There is a tympanitic note over the upper part of the left thorax; anteriorly, flatness begins at the fourth rib, posteriorly at the third spine. The dulness is movable. On the right the lower border of resonance is at the sixth rib anteriorly, and posteriorly at the eleventh spine. No breath sounds heard on the left side; on the right side the breath sounds are puerile. All the signs of pneumothorax are present on the left side. The heart: The apex beat is palpable in fifth interspace, just about ¾ inch inside right nipple line. A pulsation is visible in the third, fourth, and fifth interspaces on the right side. The heart border is inseparable from flatness of fluid on the left side. The cardiac sounds are loud, and there are no murmurs. The remainder of the physical examination was of no importance. The laboratory examinations showed a moderate leukocytosis, but never revealed the presence of any tubercle bacilli on repeated examinations. The future course of the case showed little change, save that the fluid continued to increase until the pneumothorax was almost replaced by it; finally, a thoracentesis was performed, with the evacuation of forty-two ounces of thick grayish fluid, which produced tuberculosis when injected into guinea-pigs. The patient eventually left the hospital in a much improved condition. Dr. Stengel's last note on the case is as follows: "Points especially worthy of note are: (1) The gradual development of pneumothorax—this method of development I have noted in five out of six cases seen during the past eight months; (2) entire disappearance of the air, with replacement by fluid, speaking for a healing of the rupture, and subsequent absorption of the air; (3) the failure to find tubercle bacilli."

Thus, we have here a case of tuberculosis, as proved by inoculation, with a left-sided pneumothorax developing insidiously, which at first presented the classical signs known as Laennec's pneumothoracic tripod—tympany, absence of fremitus, and absence of breath sounds. As the increasing fluid encroached upward the diagnosis became more difficult, and the possibility of confusing the tympany of the pneumothorax with the skodiac note of a "tympany by mediate relaxation" became greater, this confusion, of course, being decided by the auscultatory phenomena. The displacement of the heart in this case was very great, and its return to a more normal position after thoracentesis very striking.

Another case developing insidiously a pneumothorax in the course of a pulmonary tuberculosis was seen by me in the University Hospital medical dispensary shortly after I had commenced to study this condition, and I am sure that my diagnosis of it was in large measure due to the freshness of the subject in my mind. The diag-

nosis was agreed in by Dr. R. G. Torrey, and confirmed by skiagraph. The case is as follows:

CASE II.—J. W. M., colored, aged thirty-six years, came to the dispensary complaining of cough, pains in chest, and loss of weight. The history of the present illness dated back several months, at which time he developed a cough, which persisted, and two months before we saw him he commenced to lose weight, feel feverish, and have occasional pains in his left chest, and mild dyspnea. No history could be obtained of any sudden attack of pain or dyspnea. The patient was clearly in the last stages of tuberculosis, and examination of his lungs revealed extensive involvement on both sides. In addition, on the left side an area of hyper-resonance was met, which commenced above at the second rib, and extended down, slightly overlapping the heart, and outward to the axilla and the lower part of the posterior aspect up to the tip of the scapula. The note was less hyper-resonant just below the nipple, but in the axilla became loud and booming. Over this area fremitus was almost lost, and the breath sounds were distant bronchovesicular in character. Voice sounds were loud and egophonic in character. No metallic tinkle or succussion splash could be heard. The stereoscopic skiagraphs taken by Dr. Pancoast show a marked tuberculous involvement of both lungs. The right shows no cavity. The left shows a pneumothorax of the whole lower part of the pleural cavity, being bounded by the heart to the right, above by the second rib anteriorly, and posteriorly extending up to the angle of the scapula. The pneumothorax is crossed in front by a band of adhesions or a marked pleural scar at the level of the fifth rib. These pictures are beautiful, and demonstrate the value of the stereoscopic method, since from neither plate separately could the diagnosis have been made with certainty, but when examined in combination the resulting picture was unmistakable.

The patient was sent to the Rush Hospital under the care of Dr. T. Mellor Tyson, and died there twenty-three days later.

We have here to deal with a partial pneumothorax of tuberculous origin developing insidiously in a case of active tuberculosis. This case is in many respects typical of its kind. Tuberculosis furnishes the vast majority of cases of pneumothorax, and of the stages, it is the active in which this condition is most prevalent. Partial pneumothorax can occur only in such cases as have adhesions already present to prevent its becoming total, and it is in partial pneumothorax that an insidious onset is most frequent. All these conditions were present in this case.

A most exhaustive study of partial pneumothorax has been made by Jaccoud, who classifies them on an anatomical basis, first into superior and inferior, and the inferior again into anterolateral, posterolateral, and of the whole circumference. It is under this latter class that our case should be placed. Of course, the shape, position, and extent of a pneumothorax are entirely dependent on conditions in the pleural cavity, such as adhesions or obliterations.

A third type of case with insidious onset is well illustrated by the following case. I cannot do better than quote verbatim the notes Dr. Stengel gave me concerning this patient:

CASE III.—H. La., aged thirty-six years. His previous medical history was uneventful. Was visiting Philadelphia in December, 1903, when he contracted a severe cold, or influenzal bronchitis. His cough was severe, but not productive, and he felt quite depressed and "grippy." He was not conscious of any special oppression, dyspnea, or thoracic pain, and first consulted Dr. Stengel because some of his friends thought he was neglecting a bad cold. Upon physical examination it was found he had partial pneumothorax of the right side. The physical signs—tympany, amphoric breathing, and coin test—were found in the part of the chest midway between the base and apex, and were quite marked. The patient was sent to the University Hospital for rest and care. Within the next twenty-four hours the whole pleural sac became distended with air, and some displacement of the heart toward the left took place. Soon after this metallic tinkling developed, and after a few days a moderate effusion of liquid was demonstrable. The latter never increased greatly, and at no time rose above the level of the fifth rib in front. Hippocratic succussion was pronounced when the fluid was at its height. The patient was in the University Hospital from December 11, 1903, to January 8, 1904, and was subsequently under observation outside the hospital for another month. During this entire time his temperature was constantly subnormal, and without marked diurnal variations; the pulse rate was never above 90, and much more commonly below than above 80; the respiration rate varied between 20 and 26. After the first few days all cough subsided, and never subsequently recurred. Repeated examinations failed to show any indications of a pulmonary lesion; the superficial glands were not enlarged, and the patient's general nutrition improved steadily from the day he took to bed. The pleural effusion was absorbed within two weeks after its appearance, and soon after this the amphoric breathing ceased, indicating a probable closure of the pulmonary rupture or fistula. This was speedily followed by diminution of the pneumothorax, and within a month by its complete disappearance. The patient was repeatedly examined after his recovery, and no indications of a pulmonary lesion could be detected. He is at this date in perfect health. The most surprising features in this case were the insidious development of a complete pneumothorax, and the absence of marked subjective symptoms affecting either the circulation or respiration, and the absence of discomfort of any sort, which is witnessed to by the patient's utter lack of realization of his condition, and is more remarkable in view of his being himself a well-trained physician. The failure to detect any evidence of tuberculosis of the lungs at the time of the illness and the absence of such during the intervening seven years confirms the diagnosis made at that time of

pneumothorax, due to rupture of a superficial air vesicle during a paroxysm of coughing.

These three cases just reported will serve to show the occurrence of pneumothorax, both partial and complete, with insidious onsets under varying conditions. This type of onset is obviously not infrequent, and the large number of cases in which unsuspected pneumothorax is found at autopsy makes it certain that it is quite a common happening. Every author writing on this subject of recent years recognizes both types of onset, and quite a number, among others Emerson,[2] in his monograph, and James,[3] in Osler's *Modern Medicine*, quote the figures of Saussier in his Paris *Theses*, 1841, to the effect that in 196 cases reported there were 68 with sudden onset. At first sight these figures appear remarkable, and it would be discouraging for us to have to believe that seventy years ago clinicians were recognizing three times as many insidious pneumothoraces as of those developing suddenly. However, Emerson, in the same monograph, several times speaks of Saussier as having been able to collect only 169 cases, and this suggested a possible error. A glance at the original thesis showed the trouble. On page 6 Saussier says: "Les observations sur les quelles mes recherches sont appuyées se montent a 169 et ont été recuillies à une foule de sources;" and later, on page 68: "Les symptomes du pneumothorax ou de la perforation ont paru subitement ou d'une manier lente dans 196 cas ou on a pris la peine de les indiquer, savior: 68 fois d'une subsite et 28 fois d'une manier lente." It is an apparent typographical error, which turns 96 into 196.

Thus, instead of his figures showing a sudden onset in 68 out of 196 cases, they really show a sudden onset in 68 out of 96, or in more than two-thirds of the cases. There is no question that this is the proper interpretation of his figures, since the sum of 68 and 28 is 96; and since having been able to collect only 169 cases, he would scarcely say that in the 196 cases in which the trouble was taken to indicate the onset there were 68 sudden and 28 slow.

This unfortunate author has been quoted from generation to generation throughout medical literature in such a way as to precisely reverse his actual findings, and to complete his discomfort, his name in Osler's *Modern Medicine* is misspelled.

It has seemed worth while, therefore, to collect the figures in a series of cases concerning the type of onset. Of course, no statistics on such a point are free from criticism, especially if culled from the literature, for certain factors determine which cases shall be recorded. However, the number of cases obtainable is so large, and certain individual reports are of such considerable numbers, that the figures are surely approximate.

In the literature of pneumothorax there occur several extensive monographs, and of these the most recent and satisfactory is by Emerson, published in 1903. In this work Emerson gives abstracts

[2] Johns Hopkins Hospital Reports, vol. xi, p. 434.
[3] James, Osler's Modern Medicine, vol. iii, p. 875.

of some 358 articles on this subject, and I had hoped at first to be able to collect a sufficient series of cases from those abstracts; but this proved to be impossible, as but few of them detailed the histories of the cases reported. I was therefore obliged to refer directly to the original articles in the majority of instances. Over 1500 cases were reviewed, being found in 180 references in the literature from 1841 to the present time. Of these 1500 cases, 500 were found which gave perfectly satisfactory and sufficient histories of the onset. Every doubtful case and every case which had been subjected to trauma or tapping was omitted. With regard to the onset only two groups were made, sudden and insidious, and the cases were found to be divided as follows: 385 sudden and 115 insidious, adding to a total of 500. These figures expressed in percentages give 77 per cent. sudden and 23 per cent. insidious cases.

This percentage does not probably represent the number of cases with insidious onsets for several reasons: (1) Many cases of pneumothorax with insidious onset are not recognized; (2) fewer of the cases with insidious onset are reported, and (3) many cases with a probable insidious onset had to be ignored on account of insufficient history, whereas in no case of sudden onset would the author fail to mention this striking feature. Nevertheless, the statistics are better than none or incorrectly quoted ones.

In looking over the mass of literature on this subject, many interesting points presented themselves; among others, the fact that there is no relative increase in the cases with insidious onset reported of recent years, as might be expected, and that the figures just quoted, representing almost the entire literature, vary but little from Saussier's true figures collected seventy years ago.

Another point which cannot be overlooked is the large number of cases reported in which a pneumothorax followed tapping of the pleural cavity. The early writers did not emphasize this possibility very strongly, and Biach,[4] in 1880, could find only 3 cases with this etiology out of the 918 he studied. More recently, however, several authors have reported larger numbers. Emerson in 1903 mentions 10 cases out of the 49 he reports, and Ayer,[5] out of 72 cases of pneumothorax, finds that 14 surely followed tapping, while 9 additional ones may have been similarly caused. The actual cause of pneumothorax following aspiration is in many cases obscure, and a number of possible explanations have been suggested: (1) Faulty technique, permitting air to enter from outside; (2) wounding of the lung, with the needle; (3) negative pressure may cause the rupture of an emphysematous bleb, or hasten the breaking through of a tuberculous cavity, or adhesions may lead to a tear of the visceral pleura; (4) gas may be liberated from the blood to fill the vacuum; (5) local respiration of the tissues. However fanciful some of these may seem, it appears incredible that faulty technique can be respon-

[4] Wien. med. Wochenschr., vol. xxx, No. 1, p. 6.

[5] Boston Medical and Surgical Journal, vol. clxiii, No. 13, p. 501.

sible for so many cases as are quoted above by Emerson and Ayer from such institutions as the Johns Hopkins Hospital and the Boston City Hospital. It is, of course, possible that the tympanitic note which is found so frequently over the upper part of the lung after aspiration, and which is usually interpreted as a skodaic note due to relaxation, although no perfectly satisfactory explanation has as yet been advanced, may be the cause of confusion in certain of these cases. I have examined the notes of a large series of cases of hydrothorax tapped at the University Hospital, and have found only one sure case of resulting pneumothorax and a few doubtful ones. A final point in this relation is the remarkable absence of intense symptoms in pneumothorax thus produced, probably explained by the fact that the lung on the affected side was already only partially functionating, owing to compression, by the effusion for relief of which the aspiration was performed, and that respiratory compensation had been established.

As a contrast to the third of the cases I have just reported, which was a total pneumothorax developing insidiously in an apparently healthy man, I wish briefly to mention the following, for the use of which I am indebted to my brother, Dr. William Pepper:

CASE IV.—M. G., white, aged twenty-nine years, single, minister, was first seen on December 25, 1905, complaining of dyspnea and pain in the epigastrium. He gave the following history:

"Five days before admission, while smoking a cigar, the first tobacco he had smoked since a boy, he had a sharp, shooting pain about the middle of the sternum, lasting only a second. He stopped smoking, and was perfectly comfortable until the next day. While on a train he had a similar attack of pain, slightly more on the left side of the chest. This lasted for about one hour, during which time, after he left the train, and while walking, he was quite dyspneic. That evening and night he had considerable pain in the epigastrium and along the spine, and also an oppressive sensation over the chest. On Tuesday his bowels became constipated, and the pain increased over the whole abdomen, and continued along the spine. The next day he was quite comfortable until late in the afternoon, when he had a sharp pain over the whole left chest, with cramp-like pains in stomach and bowels. He was very dyspneic. The pain in the back had shifted to the left loin region, and was dull and aching in character; he had not slept the previous night on account of pain and shortness of breath. The pain in the chest had been relieved."

He was in perfect health at the time of this onset.

Physical examination revealed an almost complete pneumothorax of the left side. The signs were very clear; the left chest was fuller, and moved less on respiration than the right; fremitus was absent on the left side, and percussion gave a hyper-resonant note, less marked at the apex. The normal cardiac dulness was lost, being replaced by hyper-resonance; the cardiac dulness was found to the

right of the sternum, extending 1½ inches. Over the left side auscultation revealed cavernous breathing, metallic in character, and the voice sounds were also metallic. Metallic tinkling was occasionally heard, and the coin test was positive. In short, the signs of pneumothorax were all present and typical. The presence of cavernous breath sounds, while perhaps not so characteristic of this condition as absolute silence, is frequently seen, and should not be permitted to militate against a diagnosis of pneumothorax. The findings on the right side were normal in every respect.

The patient was only moderately dyspneic, with a normal temperature, a pulse of 128, and respirations of 28 to the minute, which, however, rose suddenly two days after admission to 44, and then ran a varying course between 30 and 40. The patient remained under observation for two months, during which time the signs in the lungs varied greatly. The notes on the case are very full, and it deserves more study than can be given here. Briefly, the signs of pneumothorax gradually disappeared, and after recovering from a complicating bilateral phlebitis of the long saphenous veins the patient was apparently restored to his former good health. The sputum was repeatedly examined, but no tubercle bacilli were found, and no evidence of any tuberculous process in the lungs discovered. The etiology of this peculiar case remains a mystery, as does also that of the previous case. They both belong to that well-recognized group of spontaneous pneumothorax occurring in apparently healthy individuals.

Since it is my desire merely to emphasize the frequency of insidiously developing pneumothoraces, and since the rest of the cases which were found do not add anything to those already quoted, a detailed account of them seems unnecessary here. In conclusion, let me say that if the figures collected and quoted above truly represent the frequency of recognized cases with these two types of onset, we are forced to the admission that a great number of insidiously developing pneumothoraces are escaping notice. This is true even if we rule out those which are clinically unrecognizable, owing to their small size or position. There is no condition which in its symptomatology more closely obeys the laws of physics and the mechanical principles involved in physical diagnosis, and surely this condition should be consistently diagnosticated by careful physical examination without the necessity of having an alarming sudden onset to direct attention to it. In a later paper I shall discuss the occurrence of partial pneumothorax, a form which, as has been said, is particularly liable to escape notice.

It was some months ago that Dr. Alfred Stengel suggested to me that it might be profitable to look up the cases of pneumothorax which had occurred in his service at the University Hospital, and although I have more or less wandered from the original intent, yet I wish gratefully to acknowledge his suggestion and the use of his cases in this paper.

O. H. PERRY PEPPER, M.D.
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PHILADELPHIA

Dear Dr. Cushing:-

I enclose a copy of Sir William Osler's letter to me about my maiden article, and a reprint of the article merely for the reference.

The review which I remember as appearing in one of the British weeklies, and which I suspected was written or inspired by Osler, I can not find after careful search. It was so much longer than the article deserved that I remember feeling sure there was some reason for it. If I can locate it I send you the reference.

With best wishes for the success of your undertaking, I remain yours sincerely

O. H. Perry Pepper.

June 20 - 1921