A

STUDY

OF

BASAL TUBERCULOSIS

BY

JOHN TELFER BOYD.
M.B., Ch.B., D.P.H.

--------oOo--------

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 – 1346

This investigation was begun at Winsley Sanatorium, Bath, where I was Resident Medical Officer from May, 1942 to May 1943. It was completed at Clare Hall County Hospital, Middlesex, where I was Assistant Medical Officer from May, 1943 to January, 1946.

It is a pleasant task to record my indebtedness to my colleagues who have assisted me in one way or another, especially to Doctor A.J.P. Alexander, Senior Medical Officer, Winsley Sanatorium, and to Doctor A.G. Hounslow, Physician, Clare Hall County Hospital, both of whom have most generously offered their criticisms, suggestions, and advice.

MAY, 1946. J. T. B.

BASAL TUBERCULOSIS

1. INTRODUCTION.

In pulmonary tuberculosis the "early" lesion of the adult type is found typically in the clavicular and infraclavicular regions. It follows, therefore, that an "early" tuberculous lesion occurring below these regions is atypical, and to such a case the term basal has been applied. The writer is cognizant of the fact that a more limited scope is often implied by the use of this term.

That this "early" lesion may have its site of origin at this lower level in the lung fields is not denied by most, but how frequently is this type of case met with? Is it just an occasional atypical occurrence? - a mere exception which proves the general rule? More important, does it today constitute a special therapeutic problem?

These are the questions which prompted this investigation, interest in which was aroused by a group of cases where the results of treatment left one with the general impression that the outlook for the basal case was unfavourable. It was considered that a study of cases that had been under treatment sufficiently long to warrant conclusions might yield some useful information about the most effective method or methods of treatment, and at the same time reveal the outlook for this type of case.

2. REVIEW OF LITERATURE.

A review of the relevant literature reveals, not only a diversity of views, but also a marked reluctance to recognise an extra apical site of origin in adult pulmonary tuberculosis.

Laennec taught that "It is extremely rare for the excavation to be first developed in the middle or base of the lung". Kidd in 1886 concluded from the literature that one case of basal tubercle occurred in every five hundred cases of pulmonary tuberculosis.

His//

His article describing two cases appears to be the earliest statistical report of basal tuberculosis. Kidd emphasised the importance of the apex of the lower lobe as the site of predilection for early tuberculous changes in contrast to the base of the lung. He also pointed out that the apex of the lower lobe may be attacked before that of the upper lobe. In the same year Fagge wrote "It never happens that the tuberculous process spreads upwards from the base of the lung into and through the upper lobe". What has sometimes been called basal phthisis is a distinct affection which has been described under the name of "chronic pneumonia". Two years later Fowler agreeing with Kidd's findings stated that "the upper and posterior part of the lower lobe is a spot only second in point of vulnerability to the apex itself. This opinion of Kidd and Fowler remained in abeyance for many years; the general belief being that pulmonary tuberculosis in the adult originated in the apex of the upper lobe and that basal lesions were invariably a sequel to the apical lesion. Thus, one finds Landis writing in 1921 "My opinion concerning basal tuberculosis is still unchanged. Children may have it but adults practically never". Later this investigator did alter his opinion, influenced no doubt by the findings in 1923 of Wessler and Assmann.

In that year Wessler produced evidence to show that clinically active tuberculosis did arise below the level of the clavicles. In the same year Assmann produced further evidence of a like nature, asserting that these early lesions could only exceptionally be demonstrated with the aid of physical signs, but that they were usually found radiologically, located below the clavicles. This was a big step forward towards the recognition of extra apical tuberculosis, and with the rapid improvement in x-ray technique "early" involvement of the lower lobe soon came to be recognised. For a time, however, there was marked disagreement between clinicians and pathologists, the latter claiming, and rightly so, that the interpretation of x-ray films was faulty.

Lesions/

Lesions occurring in the mid and lower third of the lung field were interpreted as arising from the hilum and much literature is available re this so-called "Hilar or Perihilar tuberculosis", by Alexander, Bernard and Faber, to quote only three. On the assumption that these lesions were actually contiguous to the root structures the view was advanced that these lesions were the result of either direct extension or retrograde lymphatic extension from infected paratracheal glands. Several Italian authors (Saqua, Constantini) writing in support of this pathogenesis, explain in detail the retrograde lymphatic extension. The many x-rays which these authors publish showing hilar lesions in A.P. view are not accompanied by lateral or oblique films to show that the lesions are actually hilar. The work of Sweeny et alia in 1931 on the position of primary cavitation in pulmonary tuberculosis put an end to this perplexing problem. They showed that the lesion in so-called hilar tuberculosis was sited in the lower lobe of the lung. Furthermore, they found that the upper part of the lower lobe not infrequently contained the oldest lesion in the anatomical specimen.

During the past decade, several investigations dealing with basal tuberculosis have been published. These in the main have been contributed by American investigators, whose findings will be discussed later in this thesis. In this Country, if one judges from the number of available publications, there has been a striking lack of interest in the subject. Davidson makes no reference to the subject, and Kayne et alia state that the frequency of tuberculosis of the lower lobe, apex excepted, is generally underestimated. Until recently I had been able to trace only one article, and this, by Viswanathan, dealt with a series of cases among African natives. This year Steen used a small series as a subject for a thesis, and Cohen has written on tuberculosis of the lower lobe.

3. SELECTION OF CASES.

In the present series selected cases met three requirements:

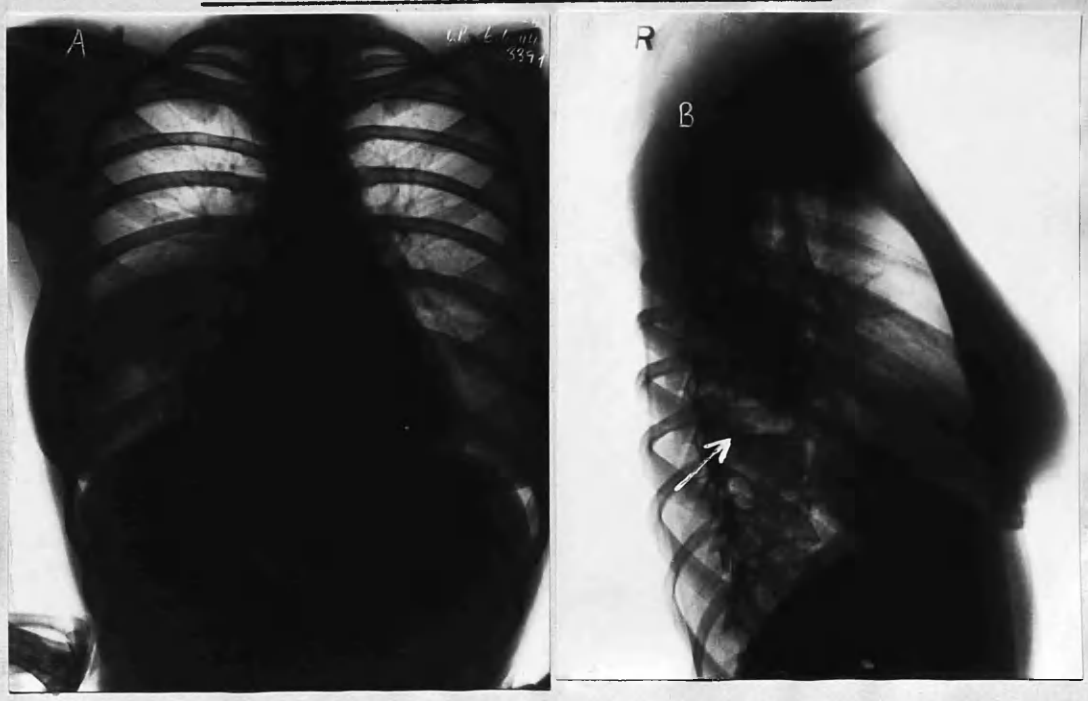
1/

1. In a postero-anterior x-ray film the basal lesion was sited below the level of the transverse process of the 7th thoracic vertebra.
2. Absence of tuberculosis in the homolateral lung field above this level.
3. If disease was present in the contralateral lung there was evidence to show that it was of more recent origin than the basal lesion.

It is customary for clinical convenience to divide arbitrarily each lung field into three zones - upper, middle and lower - by two imaginary horizontal lines drawn respectively through the lower border of the 2nd and 4th costal cartilages. The variability of the level reached by the anterior ends of the 4th rib in a postero-anterior x-ray film in different individuals precluded the use of a zonal reference in basal cases. And so, to eliminate controversy and for the sake of accuracy requirement, No. 1, as stated above, was chosen as the dividing line between typical and atypical sites for "early" pulmonary tuberculosis.

Figure I

To illustrate type of case under review



In postero-anterior view opacity with central softening extends from hilar region to mid and lower zones. In lateral view a well defined cavity with fluid level is seen to lie posteriorly in right lower lobe.

For the purposes of this investigation the records of all cases of pulmonary tuberculosis admitted to Winsley Sanatorium during the period 1935 - 1942, and to Clare Hall County Hospital during the period 1940 - 1944, have been reviewed. From a total of 4,381 cases of pulmonary tuberculosis 139 were found to be basal. Details of the two series showing classification on admission, according to Ministry of Health standards, together with sex distribution, are set out in Table I

TABLE I

	Winsley Cases		Clare Hall Cases		Total
Classification on admission:	Male	Female	Male	Female	
T.B. - or + 1	3	4	9	9	25
T.B.+2	12	17	25	47	101
T.B.+3	1	2	3	7	13
Total:	16	23	37	63	139

Unfortunately, a lateral x-ray film was not taken of the earlier cases of this series: in 94 of the later cases a lateral film is available, and all show the basal lesion to be posteriorly, i.e. in the lower lobe. In a recent investigation of basal tuberculosis Busby discarded any case with disease in the lower half of the lung if that disease was near the anterior chest wall. His study is really one of lower lobe tuberculosis, but whether cases involving primarily the apex of this lobe are included is doubtful.

In Table 2, showing the incidence of basal tuberculosis as found by/

by various investigators, where figures from investigators titled "Lower Lobe Tuberculosis" are shown, there has been evidence that basal cases have been under review.

TABLE 2.

Investigators	Year	Subject	No.of Cases.	Incidence.
Lathrop & Lyman	1924	Basal Tub.	59	2.8%
Durham & Norton	1927	- do -	26	not stated.
Ross	1930	Tuberculosis in Nurses.	11	18%
Gordon & Charr	1933	Basal Tub.	5	1%
Hamilton & Fredd.	1935	Lower Lobe Tuberculosis	10	3%
Weidmann & Campbell.	1937	- do -	40	2.8%
Busby.	1939	Basal Tub.	52	1.8%
Andosca & Foley.	1943	Basal Tub.	32	1%
Steen.	1945	Basal Tub.	25	2.1%
Present series	1945	Basal Tub.	139	3%

There were 86 females and 53 males in the combined series. This higher proportion of females is a feature noted by all investigators. In a series of 40 cases, Weidmann and Campbell found 29 females and 11 males, while Reisner in a study of 34 cases reported a 6 - 1 ratio.

Table 3 shows the age grouping of the cases. 87% were between 15 and 30 years. The oldest patient was 44 years old and the youngest 15 years.

TABLE 3

Age Groups

	15 - 20	21 - 25	26 - 30	31 - 35	Over 35
Females	22	32	13	12	7
Males	24	12	8	3	6

In/

In the series, 95 were found to have a right-sided lesion, and 42 a left-sided lesion, while two cases showed bilateral basal involvement. This significant difference in the incidence on the two sides is a feature noted by most authors as shown in Table 4

TABLE 4

Investigators	No of Cases	Right-sided	Left-sided	Bilateral
Steen	25	14	7	4
Andosca & Foley	32	22	10	-
Reisner	34	24	10	-
Weidmann & Campbell	40	28	12	-
Viswanathan	41	34	7	-
Busby	52	40	12	-
Present series	139	95	42	2

4. CLINICAL FEATURES.

(a) Symptoms:

32 cases of the combined series gave a history of haemoptysis as the earliest symptom, while a further 18 were found to have had an haemoptysis prior to diagnosis, but in whom there were other symptoms, e.g. cough with sputum, or loss of weight. In 30 the disease manifested itself by sudden onset of acute pleural type of pain on the affected side. 3 cases simulated pneumonia, and at the outset were treated as such. Thus, for the whole series the onset of symptoms could be regarded as acute or sudden in approximately 46% of cases.

In Table 5, acute symptoms in a series of "typical" or apical type of tuberculous cases taken from 100 consecutive discharges from Clare Hall County Hospital in 1944, and like findings in the 100 basal cases studied at Clare Hall are set out. Though figures involved are small, the percentage of basal cases exhibiting an acute or sudden onset is significant, and pleural pain as an initial symptom a striking feature.

TABLE 5/

TABLE 5

	Classification on admission.			Total No of cases	Haemoptysis at onset	Haemoptysis "early"	Pleural pain at onset	Simulating pneumonia
	+1	+2	+3					
Apical :	20	70	10	100	14	6	2	0
Basal :	18	72	10	100	21	11	21	3

Reiche in a study of 1,932 cases of pulmonary tuberculosis found 9.2% had more or less profuse haemorrhage as an initial symptom, but recently Lloyd has suggested that haemoptysis "occurs as the earliest symptom in only a small percentage of cases". A percentage of 23% in the present combined series showing an initial haemoptysis, and a further 13% giving a history of haemoptysis prior to diagnosis, would appear to make haemoptysis in basal cases a noteworthy symptom.

The onset of symptoms in basal tuberculosis has been described by B. Gordon and Viswanathan as insidious as in the typical apical form of the disease. The latter, however, noted a shorter history. Ross found that the onset tended to be acute, while Reisner described a number of his patients as presenting a pneumonia-like syndrome in the initial phase. Such dramatic manifestations as haemoptysis and acute pleural pain make the patient seek medical advice earlier. The average time lag elapsing between the appearance of symptoms suggesting pulmonary tuberculosis and a diagnosis being made in this series was 3.8 months. In 60% of the cases the diagnosis was made in under three months. Maxwell in an examination of a series of 340 cases diagnosed as chronic pulmonary/ tuberculosis for the first time in the out-patient clinic of the Royal Chest Hospital, London, found that the average duration of symptoms prior to diagnosis was almost exactly one year; and that in only one-third of the cases was the diagnosis made in less than three months from the onset of symptoms.

It is generally accepted that delay occurs before the diagnosis of pulmonary tuberculosis is established, and most authors are agreed that part of the delay is due to the development of disease in the absence of symptoms. It is impossible to be dogmatic, but the outstanding features in the symptomatology of the present series of basal/

basal cases suggests that this type of disease manifests itself early.

(b) Physical Signs:

Physical signs were in the majority of cases vague; a few post tussive rales at one base being the most constant finding. It was exceptional to be able to elicit signs of excavation even when with the guidance of an x-ray film the location of the cavity was known. This, however, is a fairly common finding in the apical case.

Attention has been drawn to this so-called silent feature of basal cavities by several investigators and explanations offered. Desserier considered the inability to diagnose juxta hilar cavities by auscultation due to the thick covering of lung tissue. But, Torning and Springborg in a study of 21 cases of lower lobe cavity (each cavity measured at least 2 cms. in diameter) located below the level of the pulmonary artery at the hilum of the lung, found the cavity to be posteriorly. In view of the size of the cavity and the thickness of lung tissue at the level stated they concluded that "only very faint pathological sounds are formed in these cavities".

(c) Sputum Findings:

Tubercle bacilli were found in the sputum of 133 of the cases prior to or on admission. In only 10% of these was it necessary for diagnostic purposes to resort to special methods of sputum examination, viz. concentration and culture. Five cases, though T.B. negative, had definite radiological evidence of tuberculous cavitation. The remaining case (No. 1 appendix) was diagnosed in a general hospital as lung abscess chiefly on radiological findings and operated on with disastrous consequences. Sputum had not been cultured, and the bronchoscopic smear proved T.B. negative on direct examination only. This high percentage of "open" cases has not been the experience of some American investigators. Thus, B. Gordon states "It is a curious and important/

important fact to note that often tubercle bacilli are found only after repeated examinations or following bronchoscopy". He is of the opinion that the difficulty arises because basal tuberculous lesions are less "open" than apical ones. Experience in the present series lends little support to this view: in fact, the findings rather suggest an opposite claim.

It is here appropriate to note the special bacteriological methods used in the examination of sputa for Tubercle Bacilli. In a case of suspected pulmonary tuberculosis where sputum is repeatedly negative on direct examination using Ziehl-Nielsen method of staining, it becomes necessary to use a concentration and culture method of examination. At Winsley Sanatorium I found the following procedure in such cases reliable.

Method: Using a sterile loop or pipette, the likely part of a morning specimen of sputum, or preferably the whole specimen, is placed in a sterile centrifuge tube. Twice the volume of 4% Caustic Soda is now added from a burette, and the tube is corked with a sound sterile rubber stopper. The tube is now shaken vigorously to homogenise the specimen - this usually takes five minutes - and then 4% Hydrochloride Acid is added to neutralise the contents. The uncorked tube with contents is centrifuged for twenty minutes at 3,000 revs. per minute. Most of the supernatent fluid is then run off and discarded, enough being left to mix with the deposit to obtain a fluid inoculum. Using a sterile pipette with rubber teat attached, inoculation is made on a Lowenstein-Jensen medium. If it is desired to examine the concentration, a portion of the deposit is placed on a slide, fixed by heat, and stained in the ordinary way.

This method has in the past year been criticised on the grounds that 4% Caustic Soda has little disintegrative and dissolving action on mucus.

At/

At Clare Hall Sanatorium "The Acid Peroxide Iron" method of sputum treatment has been used. Sulphuric Acid and Hydrogen Peroxide in the presence of Ferrous Sulphate are potent solvents of mucus.

Method:

Solution A		Solution B
Ferrous Sulphate:	20 gms	
Sulphuric Acid :	20 ccs	Hydrogen Peroxide: 1%
Distilled Water :	180 ccs	

To 5 ccs. of sputum 3ccs of Solution A and 3 ccs. of Solution B are added, and the mixture thoroughly shaken. Then centrifuge for ten minutes at 3,000 revs. per minute and discard supernatent fluid. The sediment is washed with 5% sodium citrate, and the deposit finally inoculated on Lowenstein-Jensen medium.

In a patient producing no sputum, laryngeal swab or swabs have been taken and treated as follows:

Method: To the sterile swab container (test tube) is added 6% Sulphuric Acid. This is allowed to act on the swab at room temperature for ten minutes and then decanted. 1 cc. of 4% Caustic Soda is now added, and after one minute the container is filled up with sterile distilled water. Phenol Red is used as indicator. Inoculation of medium is made directly by treated swab, which should now be slightly alkaline. Inoculated tubes are incubated at 37°C, and in the absence of growth incubation is continued for six weeks before considering the result negative. Human colonies appear most commonly between twelve and sixteen days following inoculation.

(d) Temperature

A definite statement about the prevalence of fever cannot be made because of the frequently delayed admission of cases to the Sanatorium.

(e) Blood Sedimentation Rate

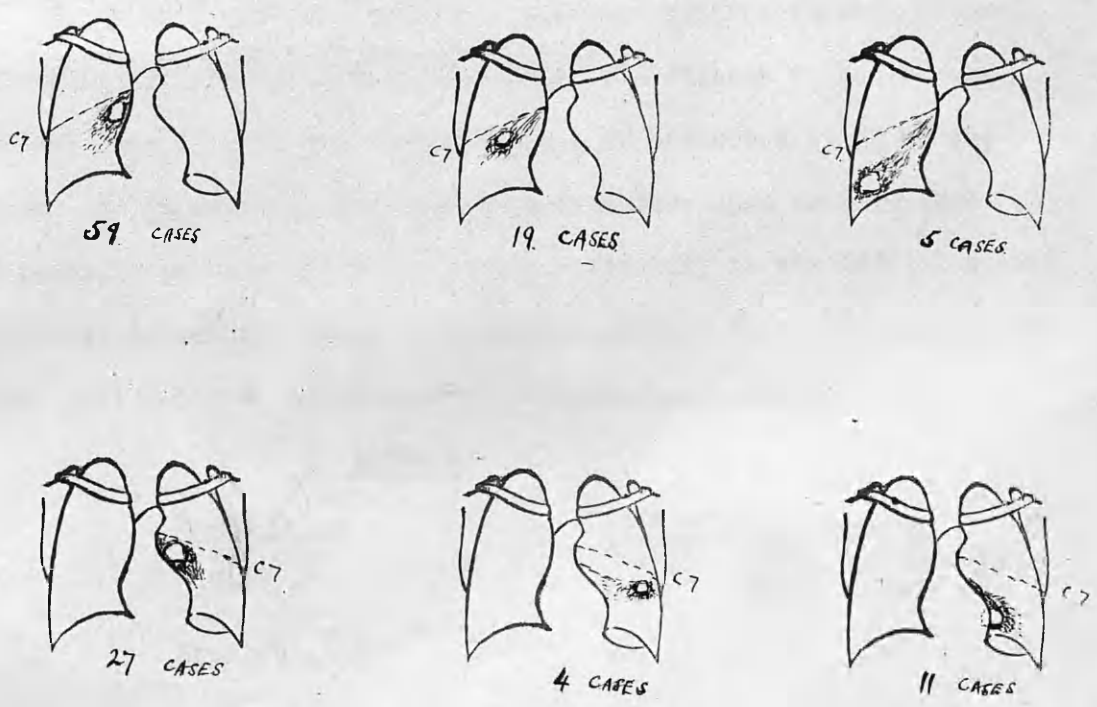
Using a 200mm Westergren tube and recording hourly and two-hourly readings the blood sedimentation rate was estimated in each patient on admission and monthly during the period of Sanatorium/

Sanatorium treatment. Taking one hour readings below 7mm. and below 10mm. as normal in the male and female respectively, eight female patients and sixteen male patients had on admission normal rates. The test, while of no assistance in diagnosing a lesion as tuberculous, was of undoubted value when assessing the progress of each case under treatment.

5. RADIOLOGICAL FEATURES

In contrast with infraclavicular lesions where in a proportion of cases a productive element is present, basal lesions are invariably exudative. Cavitation was demonstrable in the initial postero-anterior film in 125 cases or approximately 90% of the present series. It was found that the cavitation occurred at three particular sites in the lung primarily involved. These have been represented diagrammatically in Figure II. In 109 cases the predominant lesion was sited at hilar level and in 86 of these it was juxta-hilar in position. Reference has previously been made to the exact location of these hilar lesions, but it is here appropriate to stress the value of a lateral x-ray film in all such cases. Kayne et alia write "Shadows in the region of the hilum must be interpreted with the utmost caution, and interpretation should, in fact, not be attempted without the help of lateral films and screening".

Figure II



The cavities in the main could be described as thin-walled, and of variable size; the largest measured 2" in its widest diameter. A fluid level was noted in the cavity of 36 cases. Involvement of surrounding parenchyma is variable in extent. In a few cases the picture is one of a clearly defined punched out cavity with little or no adjacent reaction. The majority, however, do have associated areas of "soft" mottling, and this in some may be so extensive and confluent as to give a pneumonic appearance (See Figure I).

The fact that only a few have been observed in a precavernous stage would appear to indicate that there is a tendency to early cavitation in basal cases. In support of this Cases Nos. 2 & 3 (Appendix) may be cited. The latter, while on the nursing staff of Winsley Sanatorium suddenly coughed up half an ounce of bright blood one morning. An x-ray taken the same day showed a small patch of "soft" infiltration in the left lung field at hilar level. There was no obvious cavitation. In spite of absolute rest the lesion "broke down" and within fourteen days a cavity the size of a walnut was demonstrable. A similar sequence of events was noted in Case No.2 (Appendix). This rapidity of development of cavitation has been noted by others, namely Reisner, Weidman, and Campbell. Busby found excavation present in approximately 60% of the cases on admission to Sanatorium, while Andosca and Foley report cavitation present in approximately 78% of their series.

It is here convenient to note another striking feature of basal tuberculosis, namely an early spread of the disease to the contra-lateral lung. This had occurred prior to admission in 50 of the cases, and during treatment fresh lesions developed in a further 30 cases. Details shown in Table 6 refer only to the initial spread, which was invariably found to have taken place, to the contralateral lung, indicating a "spill over" or bronchogenic spread.

TABLE 6

Basal Cases	Site of Early Spread		
	Upper Zone	Mid Zone	Lower Zone
Right sided:	21	15	15
Left sided:	15	9	5

The fresh lesion most frequently affected the contralateral infraclavicular region whether the original basal lesion was in the right or left lung. Reisner reports a similar finding, and other investigators though not commenting on the site of the initial spread, do report a high incidence of contralateral bronchogenic spread, viz. Steen 10 out of 25 patients, and Weidman and Campbell 19 out of 40 cases.

Figure III illustrates the early bronchogenic spill-over occurring in a case within one month of admission to Sanatorium.

Figure III

Right lung: Large cavity at sub hilar level with surrounding soft mottling.

Left lung: appears clear.

Right lung: Cavitation persists with well defined fluid level.

Left: Soft mottling extending from hilum and mid and lower zones.

6. DIFFERENTIAL DIAGNOSIS.

The more common conditions that should be considered in the differential diagnosis of this type of lesion are:

Bronchiectasis,
Lung Abscess,
Pneumonia,
Lung tumours,
Pneumonitis.

Bronchiectasis. Both varieties, congenital and acquired, may closely simulate phthisis. In the former, often referred to as "dry" bronchiectasis, the patient, who is frequently a young adult, comes under observation by reason of an unexplained haemoptysis. There may be a history of cough, but sputum if present is minimal. The condition in the majority of cases is unilateral and physical signs of disease as in basal tubercle are few, and may be absent. In the latter, or "wet" variety, what may be called the typical text book case; with offensive breath associated with a large quantity of foul-smelling sputum, which is coughed up mainly in the morning, and showing evidence of toxic absorption, and often with physical signs of excavation in the lung; is generally easy to recognise. But it is more common to find a case of "wet" bronchiectasis at an earlier stage of development, and in such a case the symptoms are likely to be persistent cough with a moderate amount of sputum in the morning, which, though purulent, is not necessarily offensive. There may be also haemoptysis.

Toxic symptoms are usually absent, and physical signs most often consist of impaired percussion note at one base with weak breath sounds and persistent rales. Thus, the combination of haemoptysis and few physical signs of disease at the base of one lung may be common to either bronchiectasis or basal tuberculosis. Examination of sputum for tubercle bacilli is of paramount importance, and if this is negative by the direct method, culture of sputum should be carried out. It is well to remember that the presence of bronchiectasis does not exclude the presence of an active tuberculous lesion. A straight x-ray will usually assist in the diagnosis/

diagnosis, but a bronchogram is necessary to establish a diagnosis of bronchiectasis.

Lung Abscess. In this condition it is the radiological appearances which may closely resemble that of basal tuberculosis. Thus, in the initial period before any gross destruction of lung tissue has taken place, the radiological picture can be very similar to that presented by the "soft" cotton wool type of lesion so common in basal tuberculosis. Such a picture helped to lead to a mistaken diagnosis in Case No.1 (Appendix) previously referred to, and illustrated in Figure IV.

Figure IV

Right lung: Soft homogenous opacity extending from hilum to mid zone.
Left lung: Appears clear.

When suppuration has occurred and progressed to the formation of an abscess cavity, resemblance to a tuberculous cavity may be quite marked. As a rule the latter has a thin wall with little surrounding infiltration in contrast to the thick wall and well marked area of pneumonitis in the parenchyma surrounding a lung abscess. Kayne et alia remark that "The skiagram may strongly suggest a pulmonary abscess, but the appearance of the shadow is never conclusive."

Error, however, is not likely to arise in interpretation of appearance if close attention is paid to history and other clinical findings. Thus, there is often a history of an operation on the upper respiratory tract, a foreign body in bronchus, or symptoms characteristic of pulmonary infarct are present. The sudden appearance of a large amount of foul pus as the abscess ruptures into a bronchus is a characteristic sign. The sputum should always be examined for tubercle bacilli and other pathogenic organisms. Where no sputum is produced it is advisable to carry out bronchoscopy, obtaining at the same time smears for bacteriological examination.

Pneumonia. Friedberg in a recent paper describing a case of exudative tuberculosis confined to a lower lobe and simulating lobar pneumonia gave the following points in favour of tuberculosis as a cause:

1. The patient looked "too well".

2. Absence of dyspnoea.

3./

3. Physical signs of disease were more advanced in 24 hours than one would expect to find in a case of lobar pneumonia.

4. Lack of response to chemotherapy.

In the three cases of the present series pneumonia-like at onset, Point No. 4 was noted in each, and subsequent sputum examination clinched the diagnosis.

Lung Tumours. The benign adenoma of bronchus occurring in 50% of cases in patients under 40 years of age and showing a definite predilection for females, has frequently been diagnosed as tuberculosis. Haemoptysis is a common feature, and radiologically a collapsed lower lobe may be the outstanding feature. Such a radiological appearance was found on admission in Case No.2 (appendix) of this series. Brock in discussing this type of tumour lays emphasis on the frequency of mistaken diagnosis by citing three of his own cases, all of whom had been labelled tuberculous, and had varying periods of sanatorium treatment: one case for years. He says "In each of the three cases the outstanding feature on radiological examination was a collapsed lower lobe and this should have lead to a correct diagnosis much earlier". In such cases examination of sputum for tubercle bacilli and bronchoscopy are called for. Carcinoma of lung originates most commonly in a bronchus and so early symptoms are likely to be cough, sputum, and haemoptysis.

At an early stage radiological examination may be indefinite, and so recourse should be had to special investigations. These should include examination of sputum, bronchoscopy and bronchography.

Pneumonitis or atypical pneumonia. This condition figures prominently in American literature when discussing the differential diagnosis of basal tubercle. Radiologically the appearance may be described as a patch or patches of increased density in the lung field not lobar in distribution. The lower zones are found to be involved in a high proportion of cases. B. Gordon reports that "A striking feature/

feature is the basal involvement of the right lung". In a recent investigation of 168 cases Turner found the lesion sited in the Right Lower Zone in 42 cases, and in the Left Lower Zone in 31 cases. The clinical picture is fairly uniform. Beginning with high fever which persists without remission for seven to ten days and gradually increasing cough with production of characteristic blood-stained sputum. Another feature is a normal white blood count, which remains so in the uncomplicated case.

7. ETIOLOGY.

The pathogenesis of pulmonary tuberculosis of the adult type is a controversial subject. Thus, whether the disease arises as a result of exogenous super-infection or endogenous exacerbation, or a combination of both, is not known, nor is the path by which infection reaches the site of the initial lesion. Predilection in the typical adult case for the upper zone region of the lung fields has been ascribed to such factors as less respiratory movement and poorer blood supply in that region. Assuming that diminished movement in a particular area of lung favours the development of a tuberculous lesion there, to what extent is this likely to be a factor in basal cases?

While the investigation throws little light on the larger question, there emerges one factor, namely, diaphragmatic movement, which would appear to play a not unimportant part in the occurrence of atypical tuberculosis in approximately 3% of cases. The diaphragm, as pointed out by Keith, controls the amount of movement and degree of ventilation of the lower lobes of the lungs; the greater the excursion of the organs the better the aeration. It is known that in quiet respiration only the lower halves of the lower lobes are used. Thus, any limitation of diaphragmatic movement will lead to defective aeration in part or parts of the lower lobe. It is reasonable to suppose that the part of the lobe so affected will be remotely sited, i.e. at apex or sub-apex. The former is recognised as a not uncommon site for early tuberculous infiltration, and the latter has/

has been found the site involved in 78% of cases in the present series. If this be a favourable factor, then we would expect to find a higher incidence of basal lesions in women, and also a greater number of right-sided lesions, for the reasons that respiration in the female is predominantly thoracic, and on the right side the liver may impede the free movement of the adjacent dome. As previously noted, such has been the finding in this series and other investigators report likewise.

Recently, it has been shown by Kymography that diaphragmatic amplitude is definitely restricted in the presence of an obliterated pleural space. Thus, this may have been the determining factor in 16 cases of the present series. In 7 of these there was a history of pleural effusion on the same side as the subsequent basal lesion, but antedating it by periods varying from two to three years. In the other 9 cases, though a history of pleural effusion was lacking, several attempts to demonstrate a pleural space failed. Steen noted a history of pleurisy in 40% of his series, but the time relationship to onset of basal disease is not made clear.

Definite limitation of diaphragmatic movement occurs during the later months of pregnancy. While this may have been a factor in only one case of the present series, Reisner found that in 4 cases the diagnosis of pulmonary tuberculosis was made soon after term, and Steen reports that symptoms of pulmonary tuberculosis developed in 2 cases within a month of delivery. Viswanathan is of the opinion that the tight mode of dress worn by the natives round the waist by restricting the excursion of the diaphragm is an important causative factor in the high incidence (6.4%) of lower lobe tuberculosis among African natives. He claims to have demonstrated this limiting effect on diaphragmatic movement by radiological screening. While most investigators agree about the importance of limited diaphragmatic movement as an etiological factor in basal pulmonary tuberculosis, there is diversity of opinion and some speculation on the subject pathology. Colton suggested that the rupture of a tuberculous tracheo-bronchial or hilar lymph node into

a/

a large bronchus, and the lodgement of a massive infection in the terminal bronchioli and alveoli lead to a pneumonic process. Andosca and Foley consider this a most likely and logical explanation. In one case (No. 5 appendix) of the present series, this undoubtedly was the sequence of events. The patient, a youth aged 16 years, was referred to the Tuberculosis Officer in September, 1941 with a history of tiredness and irritating non-productive cough following an attack of Influenza. Radiologically, the appearance was one of right hilar enlargement, together with middle lobe collapse, and mottling in the lower lobe. Left lung field appeared normal. Patch test was positive, and at bronchoscopy a mass was found projecting from the medial wall into the right main bronchus. Biopsy revealed caseation and giant cell systems typical of tuberculosis. On admission to Sanatorium two months later there was little change in the chest x-ray picture, but a trace of sputum now produced was T.B. Positive. A few weeks later a definite increase of disease with cavitation occurred in the right lower lobe. It would appear, therefore, that this was a case of primary tuberculous infection with massive enlargement of hilar glands, which on the one hand ruptured into the right main bronchus producing bronchogenic spread of disease to the right lower lobe, and on the other, caused external pressure on the bronchus to the middle lobe.

Durham and Norton considered the lesion a haematogenous one since they were able to demonstrate extra-pulmonary foci in cases which came to postmortem. It is worth remembering that they were dealing with tuberculosis in the Negro. It is, however, interesting to note that they considered this type of lesion peculiar to juveniles. Ross, who found a high incidence (18.3%) of basal pulmonary tuberculosis in young nurses, noted that prior to employment few of them had been exposed to tuberculous infection. Unfortunately, no figures for Mantoux Reactions are given. It is, however, possible that some of his cases were progressive primary infections. Early diagnosis in his cases was likely. He also

noted/

noted that cavitation was an early feature. In the present series cavitation of a primary lung focus was considered to have occurred in one case (No. 4 Appendix). A young Mantoux negative nurse after two months work in a Sanatorium developed a tuberculous focus in the left lower lobe which cavitated within one month. Mantoux became positive. Radiologically the glandular component was not obvious. Proof that this has been the sequence of events in other cases of the series is lacking. However, the radiological appearance in some cases is suggestive. In the younger patients of this series the picture was invariably one of clear-cut, isolated, thin-walled cavity with little or no surrounding reaction. This was so in 18 cases all under 16 years of age, and it is noteworthy that 5 of these were contacts of an open case in the family. While realising that the primary pulmonary focus becomes quiescent in most people it is suggested that some basal pulmonary tuberculosis cases are the outcome of a progressive primary infection.

8. TREATMENT.

It is a generally accepted principle that bed-rest should form the basis of treatment in the active case of pulmonary tuberculosis. How often by this means alone does the active case become quiescent depends primarily on the extent and type of lesion present when treatment is instituted. With minimal lesions it is generally agreed that a high proportion of such cases do well with rest alone. In the more extensive case, and particularly if cavitation be present, experience has shown that something more than rest is required to achieve control of disease.

In the present series 15 patients had routine rest as the only treatment, and the results obtained are shown in Table 7.

TABLE 7

Classification on admission	No of Cases	Condition on Discharge			Present Condition		
		Quiescent	Worse	Died	Alive, Well, Working.	Non-Quiescent.	Dead
T.B. - or + 1	5	5	-	-	2	1	2
T.B. + 2	7	4	3	-	2	-	5
T.B. + 3	3 *	1	-	2	1	-	2

Note: Cases marked # in Table 7 refer to -

1 Diabetic Case
2 Cases tuberculous laryngitis on admission.

Rest was not the treatment by choice for all 15 cases. Thus, in two of the patients disease was considered on admission too advanced to warrant active interference. Collapse therapy might have proved beneficial in three of the remaining 13 cases but could not be employed. One patient refused, another was mentally unstable, and in the third, artificial pneumothorax failed. In all three cases the disease, moderately advanced on admission, gradually progressed, and death followed soon after discharge from the Sanatorium.

In the remaining 10 cases of this group the lesion was considered quiescent at the time of discharge. Of these five are alive, well and working at periods varying from one year to six years later. It should be noted that in three of these cases there was definite cavitation present at the time of admission. Of the other five cases, one died of tuberculous meningitis six months after discharge. A second remained well for four years and then relapsed. Cavitation occurred at the site of the original right basal infiltrative lesion, but further sanatorium treatment was refused. Following rest at home for one year she is now reported by the Tuberculosis Officer as being "fairly well and able to do part-time work at home". Subsequent history in the three other cases is similar. Each "broke down" within six months of discharge from Sanatorium. One of these (No. 6 Appendix) on readmission within eight months was considered too advanced for any form of collapse therapy. The other two cases received treatment in other Sanatoria but without response. Admittedly in Case No. 7 (Appendix) there was a gross time lag between clinical relapse and readmission.

These late results of conservative treatment are not encouraging. When to this is added the fact that only five out of twenty-six minimal cases responded initially to rest (and only two

of/

of these remained quiescent) it seems reasonable to conclude that in basal cases something more than rest is needed. The other 21 minimal cases had an average period of 2.4 months on bed rest (no case had less than one month) and failing to show clinical and radiological improvement it was deemed advisable and safer to institute some form of collapse therapy.

This has not been the experience of some investigators. Thus, Steen considered the results of bed rest in minimal cases satisfactory, but the number of cases (four) involved is small. Weidman and Campbell, while advising strict bed rest as the treatment for the non-cavitary sputum negative case, realised the possible danger, and stressed the importance of frequent - at least weekly - x-rays in such a case. Busby, though reporting 100% success with bed rest in four minimal cases, concluded "it does not seem safe or justifiable to trust basal lesions to bed rest alone".

While by no means all cases of pulmonary tuberculosis require collapse therapy, one would expect, particularly in view of the high incidence of cavitation noted in basal cases, to find that in the main something more than general rest was necessary. This has been so, and to achieve the additional rest the following forms of collapse therapy have been used:

Phrenicectomy
Pneumoperitoneum
Artificial Pneumothorax
Thoracoplasty.

These measures, of proved value, today find a rightful place in modern tuberculosis therapy. All aim at providing functional rest of the lung, and by collapse of diseased part, control of the lesion. But, during the past decade - and the present series covers this period - views on when to employ each measure to the best advantage have, in the light of experience, changed, and are changing. Thus, what was considered a good initial step in the active treatment of a particular case say five years ago, would today by some be considered hazardous for the same type of case.

This/

This important fact must be taken into account when assessing results of any form of collapse therapy. Broadly speaking, the indications for instituting collapse therapy are:

1. Lesion showing evidence of progression while patient at rest.
2. Presence of cavitation.

These indications must be amplified when considering the type of collapse therapy likely to lead to control of disease in a particular case.

Phrenicectomy. Provided the pleural space is free paralysis of the diaphragm curtails the ventilating function of the lower lobe of the lung. A particularly beneficial effect is therefore likely in basal cases, since the majority are lesions affecting the lower lobe. The operation, first proposed by Stuertz in 1911, was employed by him as a therapeutic measure for basal lesions. Whether the interruption to the nerve should be permanent or temporary depends mainly on the individual case concerned, but of recent years phrenic crush has come into favour for the following reasons:

1. It has been found generally effective.
2. Loss of normal diaphragmatic movement is only temporary.
3. A minor operation and can be repeated.

This form of therapy has been employed in the present series, and results noted in Table 8 suggest that it is of undoubted value, and the indications for its use fairly well defined in the following order of importance:

1. Supplementary to Artificial Pneumothorax.
2. Supplementary to Pneumoperitoneum.
3. Treatment in "early" non-cavitary lesions.

TABLE 8

Treatment/

TABLE 8

Treatment	No of Cases	Classification on admission.			Condition on Discharge.		
		+1	+2	+3	Quiescent	Non Quies. cent	Dead
Phrenic Crush alone	8	4	4	0	5	1	2
Artificial Pneumothorax & Phrenic	45	9	32	4	34	6	5
Phrenic & Pneumoperitoneum	13	2	10	1	10	1	2
Phrenic Pneumoperitoneum & Artificial Pneumothorax.	14	2	12	0	14	0	0

In five patients phrenicectomy alone was considered to have led to control of disease. In three of these there was no cavitation demonstrable, and all have remained well at periods varying from three to five years following discharge from Sanatorium. Early cavity closure followed phrenic crush in the other two cases. One of these is a recent discharge, and the other (No. 8 appendix) was readmitted for further treatment, reactivation of the original lesion having occurred within two years of discharge. Three cases failed to respond to phrenicectomy, and artificial pneumothorax not being possible, disease progressed.

As a supplement to artificial pneumothorax phrenicectomy has proved of value. The combination was employed in 45 cases. In 34 of these, where artificial pneumothorax failed to control the lesion, phrenic crush as a supplement achieved sputum conversion in 24. It was found that degree of rise in height of dome following phrenic crush was decisive. Where this was small persisting cavitation in the lung was little affected.

Pneumoperitoneum This form of therapy, while of recent introduction to this country, has been used extensively in America during the past ten years. Vadja in 1933 first reported the effectiveness/

effectiveness of this form of collapse in the treatment of pulmonary tuberculosis, and one year later Banyai reported favourable results when using pneumoperitoneum in conjunction with phrenic nerve paralysis. In 1935 Kugelmeier reported the accidental use of pneumoperitoneum with effect, in a case of acute basal pulmonary tuberculosis where the lesion failed to respond to phrenic nerve crush, and in whom he was endeavouring to induce an artificial pneumothorax. In this country Jones and Macdonald in 1943 published their findings, and they clearly demonstrated the value of pneumoperitoneum "not as a single weapon, but as a mode of attack to be used in combination with other forms of collapse therapy".

In this role, pneumoperitoneum has been used in 27 cases of the present series with impressive results shown in Table 9. For comparison the results obtained in cases actively treated prior to the introduction of pneumoperitoneum are listed.

TABLE 9

See next page/

TABLE 9

Treatment	Number treated	Classification on admission			Condition on discharge			Incidence of Empyema	Incidence of clear Effusion.	Number with effective A.P. on discharge.
		+1	+2	+3	Quiescent	Non-Quiescent.	Dead			
Artificial Pneumothorax	40	4	32	4	31	9	0	6	5	27
Artificial Pneumothorax & Phrenic	45	9	32	4	34	6	5	5	4	29
Phrenic & Pneumoperitoneum	13	2	10	1	10	1	2	0	0	0
Phrenic, Pneumoperitoneum & Artificial Pneumothorax.	14	2	12	0	14	0	0	0	0	14

It will be seen that there is an obvious difference in the incidence of effusion (clear and purulent) in the two groups of cases. Checked statistically this difference is a significant one. The probable reasons for this difference become apparent when the salient clinical features of the cases in which effusion complicated artificial pneumothorax therapy are analysed. All were noted at time of Artificial Pneumothorax induction to have several features in common, namely:

1. Pyrexia.
2. Blood Sedimentation rate more than 20/200 in one hour.
3. Radiologically "soft" disease and obvious cavitation present.

In addition it was noted that in each case there was reason to conclude that when the effusion occurred the underlying lung lesion was uncontrolled, that is, cavitation persisted. Figure V illustrates the sequence of events in Case No. 10 (Appendix). For details of some of these cases see Appendix No. 9 to 13.

Figure V.

See next page/

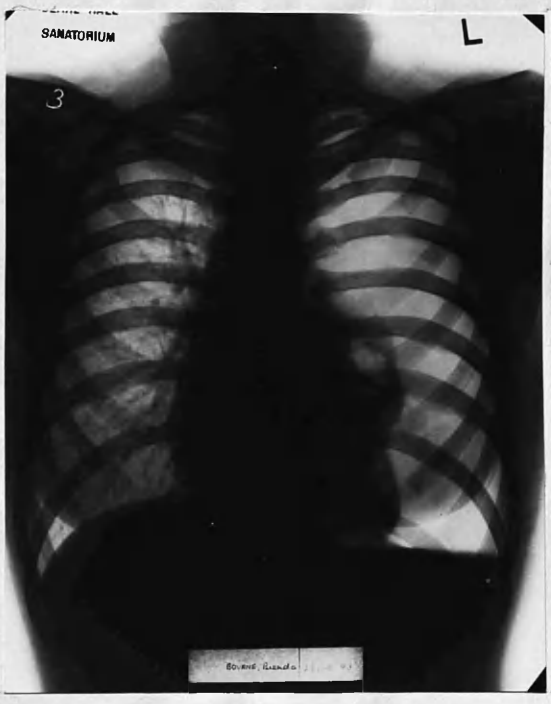
Right lung: Appears clear.

Left: Faintly defined annular shadow juxta hilar in position.

Mediastinum and heart displaced to right.
Right lung: No change

Left: A.P. Many string-like adhesions present. Cavity with fluid level definite at hilar level

---



Right lung: No change

Left: After adhesion section lung appears free. Cavity persists.
Trace of fluid in pleural space.

Mediastinum and heart displaced to right.
Right lung: Appears clear.

Left: Pyo-pneumothorax - fluid reaches to level of 2nd rib anteriorly.

An analysis of the cases having preparatory pneumoperitoneum therapy revealed that the majority were of the 'toxic' type on admission, but as a result of this therapy an alteration in the toxic state occurred. These findings are set out in Table 10:

TABLE 10.

Case No.	Clinical state at Induction of Pneumoperitoneum.			Duration of Pneumoperitoneum prior to A.P. Induction. Weeks	Clinical state at Artificial Pneumothorax Induction.		
	Temp. °F	B.S.R. at 1 hr.	Cavity		Temp. °F	B.S.R. at 1 hr.	Cavity.
14	99	25	Present	15	Normal	7	Closed
15	99	45	Present	11	Normal	13	Closed
16	99	38	Present	4	Normal	7	Smaller
17	99.4	26	Present	8	Normal	14	Present
18	100	64	Present	12	Normal	12	Closed
19	99	39	Present	8	Normal	5	Closed
20	99	40	Present	16	Normal	13	Smaller
21	99	22	Present	8	Normal	12	Closed
22	99.8	23	Present	6	Normal	10	Smaller
23	99	38	Present	12	Normal	15	Smaller
24	99	23	Present	6	Normal	11	Closed
25	99	50	Present	12	Normal	20	Present
+ 26	99	13	Present	2 years 8 months	Normal	2	Not Obvious
27	99.4	21	Present	20	Normal	15	Closed.

+ Emergency discharge. Later re-admitted for Right artificial pneumothorax when he became T.B.Positive on Laryngeal Swab culture.

With the improvement in the lung lesion there invariably followed an improvement in the patient's general condition as evidenced by reduction in temperature, blood sedimentation rate, cough and sputum. Therefore, features which are generally considered to indicate potential dangers in collapse therapy are by this means in large measure reduced. In short, in the toxic basal case pneumoperitoneum/

pneumoperitoneum prepares the patient for relatively safer artificial pneumothorax therapy.

A combination of factors is probably responsible for the beneficial effect:

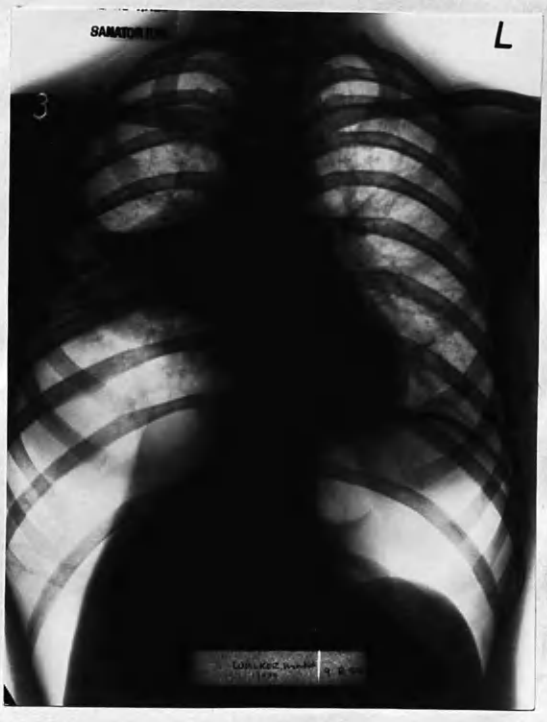
1. Displacement of diaphragm upwards leads to diminution of thoracic volume, and this allows retraction of lung tissue to take place. Relaxation will obviously be maximal in the lower lobes.
2. Alteration in the course of the bronchus (or bronchi) draining the cavity, which may lead to -
    a) Cavity closure
    b) Reduction in size of cavity with loss of "tension" element.
3. Abolition of paradoxical diaphragmatic movement.

The type and degree of relaxation and retraction obtained by pneumoperitoneum makes it desirable where possible to replace by a more uniform type of collapse, namely that obtained by a free artificial pneumothorax. How much time should be allowed for the preparatory treatment varies in the individual case. In the present series the average time for cases was found to be approximately ten weeks. When a case is considered "fit" for the next step in treatment, viz. artificial pneumothorax induction, there is no reason to delay. When pneumoperitoneum refills are abandoned one usually finds the descent of the diaphragm is slow, and in my opinion some measure of collapse by pneumoperitoneum should be maintained until artificial pneumothorax is effectively established, all divisible adhesions having been sectioned. Figures VI & VII illustrate the steps in treatment of cases 18 & 19.

Figures VI & VII

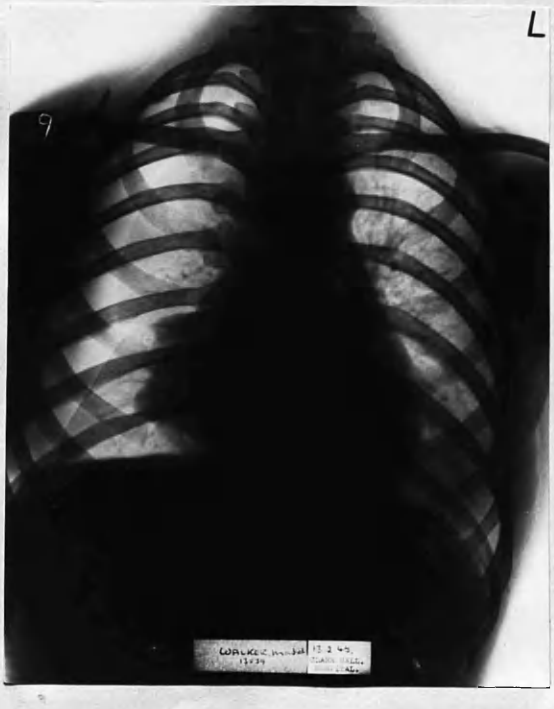
see next page/

Right lung: Soft mottling in mid and lower zones with cavity at hilar level.
Left: Appears clear.



Pneumoperitoneum present with selective rise of right hemi-diaphragm.

Right lung: Opacity persists at base but cavity no longer obvious.
Left lung: Clear.



Right lung: A.P. with effective collapse. Partial atelectasis in lower lobe.
Left lung: Appears clear.

Right lung: Appears clear.

Left lung: Cavity at extreme base with surrounding mottling.

Pneumoperitoneum present with selective rise of left hemi-diaphragm.

Right lung: Clear.

Left lung: Opacity at base persists, but cavity no longer obvious.

Right lung: Clear.

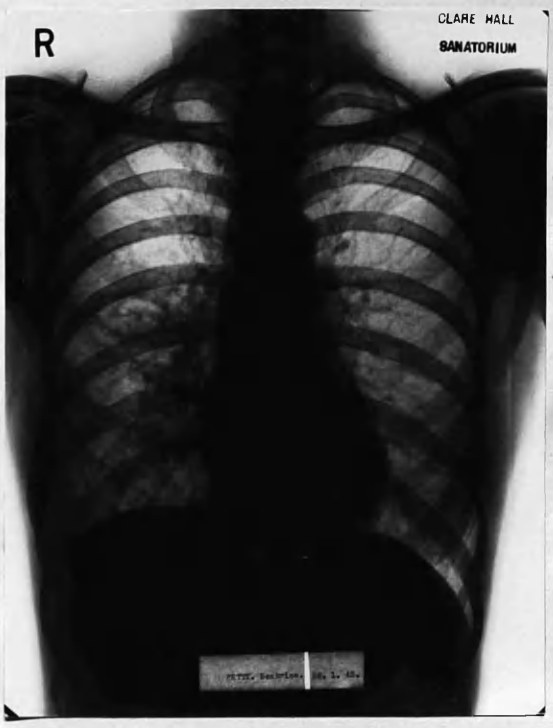
Left lung: Free A.P. Collapse appears effective.

One may find it impossible to obtain a free artificial pneumothorax owing to indivisible adhesions, and the resulting collapse is only effective by a combination of measures. Such was the case in patient No. 20 (Appendix) where on abandonment of pneumoperitoneum soon after adhesion section, which could only be partial, original cavity reopened. Following pneumoperitoneum reinduction, and with artificial pneumothorax maintained cavity closure occurred.

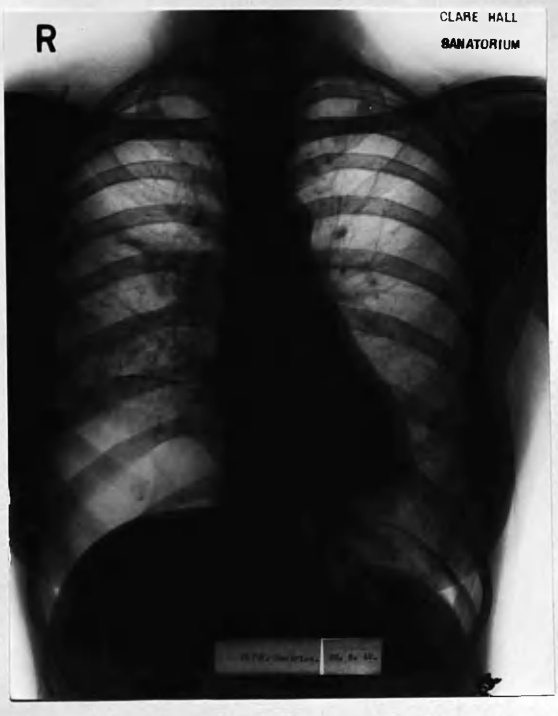
When one finds no pleural space, or a space ineffective by reason of extensive indivisible adhesions, should one maintain the pneumoperitoneum? Where it is proving effective, that is, lung lesion controlled, the answer must obviously be Yes. In 13 cases of this series, having preparatory phrenic and pneumoperitoneum, artificial pneumothorax failed. Two of these subsequently developed signs of abdominal involvement and quickly succumbed. Pneumoperitoneum in a third case, No. 28 (Appendix) failed to close the cavity, and after five months was abandoned. He is at present being prepared for radical therapy, viz: lobectomy. In the remaining ten cases maintenance of pneumoperitoneum resulted in control, and disease was quiescent on discharge. In two of these it was necessary to recrush the phrenic nerve to maintain an adequate diaphragmatic rise, but in the remainder a satisfactory pneumoperitoneum could be maintained and remained selective when diaphragm recovered function. It is as yet too soon to say how long Pneumoperitoneum should be maintained in such cases. In Case No. 32 (Appendix), illustrated in Figure VIII this measure of collapse was abandoned after two years. This patient is alive, well, and working, and disease remains quiescent one year later. In nine cases pneumoperitoneum is being maintained at periods varying from six months to three years since discharge from Sanatorium.

Figure VIII

see next Page/



Right lung: Mottling mid and lower zones with ovoid shaped cavity at hilar level.
Left lung: Appears clear.



Pneumoperitoneum present with selective rise of right hemi-diaphragm.
Right lung: Some resolution of mottling, and cavitation no longer obvious.

Left lung: No change.

Right lung: Pneumoperitoneum no longer present. Linear scar in mid zone, over site of previous cavitation. Scanty mottling in lower zone hard.
Left lung: Clear.

Technique for Pneumoperitoneum Induction. The site of induction advocated by Jones and Macdonald has been used and found a safe one. With the patient recumbent, arms by the side, an area of the abdominal wall 1 inch below the tip of the 9th left costal cartilage is anaesthetised with 2% Novocaine down to peritoneal level. A Saugman induction needle attached to A.P. apparatus is then inserted in an upward and inward direction, the needle being held at an angle of 45° to the abdominal wall. Experience alone teaches one to insert the needle to the correct depth. As a rule, there are no manometer fluctuations recorded, but I have found it helpful to listen close to the needle when the first few ccs. of air are run in. In most cases a characteristic hiss is distinctly audible during inspiration if the point of the needle is in the peritoneal space. In the successful induction liver dullness disappears early in all cases; referred shoulder pain is not a constant finding. ' While of no help initially, manometric readings soon confirm a successful induction. I have found that as soon as a satisfactory air bubble has been established (this requires 200 - 500 ccs. of air) manual pressure on the lower abdomen is recorded on the manometer provided the point of the needle lies in the air pocket. The greater this manual pressure the greater the positive reading on the manometer. On releasing manual pressure there is an immediate fall of pressure recorded on the manometer.

I have found this test a helpful guide at subsequent refills, which are given by a Morland's needle without local anaesthetic. From my experience it can be stated with certainty that if at a refill this test is negative the needle has been wrongly inserted, and furthermore, it is dangerous in these circumstances to proceed with the refill. 1,000 ccs. of air are usually given at induction, and two days later following a screen examination a similar amount is given as a first refill. Subsequent refills are spaced, relying

on/

on screen control. It has been found unnecessary to exceed an intra-peritoneal pressure of + 10 cms. of water to obtain the desired effect.

Complications. While none have been encountered in the present series, various complications can arise, and have been reported. Perforation of bowel was noted in one case by Jones and Macdonald when using a sub-umbilical site for induction. Air embolism has been reported by Fremmel, and the writer knows of a case in whom this was a fatal complication during a pneumoperitoneum refill. In this case the refill was undertaken without due care, and at autopsy it was found that air had been injected into the liver - bubbles of air were visible under the capsule of this organ. Accidental pneumothorax, reported by several investigators, is unlikely if a subcostal site for induction is used. Simmonds has recently collected details of a series of cases in which mediastinal emphysema complicated pneumoperitoneum therapy.

Results of Other Investigators, who have used the combination of phrenic nerve crush and pneumoperitoneum in the treatment of basal pulmonary tuberculosis are generally favourable. Thus, Rilance and Warring writing in 1941 found a higher incidence of cavity closure in those cases where cavity was sited in the lower third of the lung field. In a later article (1944) these authors write that "Basal cavities have responded particularly well, and where these exist the procedure might warrant first consideration before other collapse measures. Fowler, although he considered artificial pneumothorax the method of choice for basal cases, found phrenic crush and pneumoperitoneum effective therapy in six predominantly basal cases. It is interesting to note that he concluded thus "It is too soon to predict, but the results obtained would indicate the adoption of pneumoperitoneum and phrenic nerve crush as the primary weapon of attack in basal lesions".

Steen found pneumoperitoneum a satisfactory method of collapse in three basal cases: in two of these, other active measures had failed to control the lesion. More recently, Cohen in a Report

on/

on Tuberculosis of the lower lobe considered phrenic crush and pneumoperitoneum probably the best initial treatment in the case where cavitation occurred other than at the apex of the lobe. Where cavitation was sited at the apex of lower lobe he expressed doubt on the efficacy of pneumoperitoneum, and favoured artificial pneumothorax with adhesion section for this type of case.

Artificial Pneumothorax. This form of therapy has been used in 99 or 70.5% of the cases in the present series. In 39 cases it was the sole form of collapse, and of these 9 were treated bilaterally. In the remaining 60 cases artificial pneumothorax was one of a combination of collapse measures employed. The results obtained, both immediate and late, are set out in Table II

TABLE 11

Treatment	No. Treated.	Condition on Discharge			Present Condition		Re-admitted	
		Quiescent	Non-Quiescent.	Dead.	Alive & Well	Non-Q.	Dead.	
Artificial Pneumothorax	31	23	8	0	21	4	6	4
Bilateral Artificial Pneumothorax	9	8	1	0	6	2	1	0
Artificial Pneumothorax & Phrenic	45	34	6	5	31	5	4	4
Phrenic Pneumoperitoneum & Artificial Pneumothorax.	14	14	0	0	14	0	0	0

Analysis of the cases treated by artificial pneumothorax alone in whom the disease was non-quiescent on discharge reveals a high incidence of effusion (clear and purulent) complicating treatment. Thus, of the eight cases in this category, four developed tuberculous empyema, and subsequent course was rapidly downhill. In three others an acute effusion (clear) led to early obliteration of the pleural space. One of these died later of miliary tuberculosis, one,

No./

No. 29 (Appendix) was readmitted later for radical therapy, and the third, though considered ? Quiescent on discharge, was readmitted with advanced disease within three months. In the follow-up of the quiescent cases of the group, two were found to relapse. One of these, treated by Right artificial Pneumothorax in 1935, which was continued for three years, has recently had a Left artificial pneumothorax induced while on active service abroad. The other was Case No. 8 (Appendix). With two exceptions, cases requiring bilateral artificial pneumothorax did well. The patient, non-quiescent on discharge, was a severe diabetic, and in spite of two free artificial pneumothoraces, continued to be laryngeal swab T.B.Positive. He remained fairly fit for three years, when he was admitted to a general hospital in diabetic coma, and subsequently developed a tuberculous empyema. His present condition is poor. The other exception, Case No. 30 (Appendix) is interesting. On discharge, disease appeared to be satisfactorily controlled, and he remained well for two years. The left artificial pneumothorax was known to be a free one, but section of a few visible adhesions on the right side was considered unnecessary. Sequence of events is illustrated in Figure IX.

Figure IX.

See next page/

Right lung: Cavitation at hilar level with surrounding mottling.
Left: Cavitation at hilar level with surrounding mottling.

Right lung: A.P. Cavity no longer obvious. Note persisting adhesion 5th interspace anteriorly.
Left: A.P. Collapse appears free.

Right lung: Re-expansion of lung complete, with some pleural thickening at extreme base. Cavitation again obvious at hilar level.
Left lung: A.P. with some obliterative changes at base. Cavitation not obvious.

It is difficult to escape the conclusion that the result in this case would have been different had adhesion section been performed on the right side.

It is generally agreed that the outlook for a case having artificial pneumothorax is in large measure dependant upon the extent and type of collapse obtained, and it is a common observation that this therapy is worth while, provided the collapse is or can be made effective by adhesion section. Granted that several cases in the present series have been discharged with a quiescent lesion, and have remained well, in whom thoracoscopy was considered unnecessary, but is this generally safe? In the light of present knowledge it is unwise to regard an artificial pneumothorax as a free one on radiological evidence alone. Laird in a recent survey of 305 patients involving 455 thoracoscopies reported that in 18 of these cases no adhesions were seen on x-ray. At thoracoscopy six of these were found to have adhesions. He claimed that the selection of cases for adhesion section "should not rest on x-ray alone!"

In the type of case under review it is not uncommon to find what appears on a postero anterior x-ray film to be a free collapse. In the past many such artificial pneumothoraces were regarded so, even though there was failure to control the lesion. In such a case the unsuspected adhesions are found posteriorly in the "gutter", and usually form a close attachment to upper part of the lower lobe. Approximately 50% of the cases of this series having artificial pneumothorax therapy were not examined thoracoscopically, and so it was thought that a comparison of the two groups might yield some useful information. These findings have been set out in Table 12.

TABLE 12.

See next page/

TABLE 12.

Treatment	No of Cases.	Condition on Discharge		Present Condition			Complications.	
		Quiescent.	Non- Quiescent.	Alive & Well	Dead	Re-Admitted	Clear Effusion	Purulent Effusion.
No Adhesion Section	49	34	15	28	15	6	7	8
Total Adhesion Section	41	38	3	37	0	4	1	2
Partial Adhesion Section.	9	7	2	7	1	1	1	1

While it is realised that many factors are involved in the establishment of an effective artificial pneumothorax, it would appear that not the least important of the factors is divisible adhesions. The other important factors, viz: presence of cavitation in the toxic patient have been stressed when discussing pneumoperitoneum therapy.

Brook's Bag. An ancillary method introduced in 1938 was an endeavour to close a basal cavity which persisted in spite of a free artificial pneumothorax. The temporary insertion of a balloon per bronchoscope to produce bronchial block and so collapse the affected lobe was claimed to lead to cavity closure. This method was employed in two cases of this series, but without marked success.

Results of A.P. therapy by other investigators are set out in Table 13:

TABLE 13.

Investigator	No.of Cases	RESULTS. Satisfactory	Partial Satisfactory	Not Satisfactory.
Busby	22	6	-	16
Colton	7	5	-	2
Reisner	19	11	-	8
Steen	9	4	-	5
Wiedman & Campbell	15	6	6	3
Torning & Springborg	17	13	-	4

These results are on the whole far from satisfactory and in my opinion do not substantiate the general claim put forward that artificial pneumothorax for this type of case is the best initial treatment. It seems reasonable to make the following comments on these variable results:

1. Where adhesion section was employed (and this has been exceptional) results are more favourable. Thus, Torning and Springborg obtained a satisfactory result in all cases where/

where pneumolysis resulted in a free artificial pneumothorax. More often, however, thoracoscopy was little employed and for this reason adhesions may have been overlooked. Thus, Riesner noted several instances where artificial pneumothorax gave unsatisfactory results stating that "though no adhesions demonstrable radiologically, cavity could not be collapsed". Busby in a series of 52 cases used pneumolysis in three only. Wiedman and Campbell, while recommending early artificial pneumothorax as method of choice, did stress the fact that adhesions may be missed radiologically, but considered the results far from brilliant irrespective of the collapse therapy employed.

2. Fluid was a serious complication of artificial pneumothorax therapy in at least two of the investigations. Thus, Busby encountered fluid requiring aspiration in eleven cases, and in eight of these the fluid was T.B. Positive. Steen reported fluid as a complication in seven of the nine patients having artificial pneumothorax, with serious consequences in four of them. In spite of this he concluded that artificial pneumothorax should be the first line of treatment for basal tuberculous lesions.

Radical Therapy:

Thoracoplasty. One Case, No. 31 Appendix of the present series has had this collapse measure performed as part of a combination of treatment. In this case, treatment by left artificial pneumothorax and phrenic crush in 1939 was ineffective (adhesion section not attempted), and prior to abandonment of artificial pneumothorax ten months later left phrenic nerve was evulsed. This was followed by a bronchogenic contralateral spread for which a right artificial pneumothorax was induced in 1941. In 1943 when she came under my care she was found to have a partially satisfactory right artificial pneumothorax, and an active lesion in the left lung, which now involved the upper lobe. Following adhesion section on the right side and pneumoperitoneum there was marked local and general improvement, and a partial left thoracoplasty was undertaken and completed without upset. Though still

in/

in hospital she is well, sputum free, gaining weight, and radiologically combined measures appear to control the disease.

Busby submitted one of his cases to thoracoplasty with ineffective result. Wiedman and Campbell report one case so treated with effect. Remembering that a fairly extensive thoracoplasty is necessary it must be very exceptional to find in a case of basal tubercle requiring this radical measure general and local conditions to warrant the major operation.

A selective thoracoplasty for persistent basal tuberculous cavitation described by Freedlander in 1938 appears to have had a very limited trial: he reported two cases in whom the immediate results were satisfactory.

Pneumonectomy and Lobectomy. In one case, No. 29 (Appendix) of this series, a pneumonectomy was considered advisable and has recently been performed - 8/10/45. This patient had a right artificial pneumothorax induced in 1942 which obliterated ten months later following an acute pleural effusion. On admission in 1945 she was found to have a tight stricture of the right lower lobe bronchus with lobar collapse. In the interval disease had spread to involve the ipsolateral upper lobe, but the left lung appeared clear. General condition of patient was good. At operation separation of pleural layers proved easy and removal of lung presented no difficulty. Unfortunately, a "spill over" of infection did take place (presumably during operation) but this at time of writing shows signs of resolution and patient's general condition remains good. The outlook in this case is doubtful.

A further case, No. 28 (Appendix) on whom a phrenic crush and pneumoperitoneum has failed to close a right lower lobe cavity, is considered suitable, and will shortly undergo lobectomy. The lesion has remained strictly localised, and general condition of patient is excellent. Lobectomy and pneumonectomy in the treatment of pulmonary tuberculosis has recently been reported with some success in America. In 1943 Churchill and Klopstock reported on six successive lobectomy cases. In one of these the lesion

was/

was confined to the right lower lobe. The patient, a woman aged 38, was found in March 1938 to have an infiltrative "hilar" lesion. Sputum was T.B. Positive. She was admitted to a Sanatorium and treated conservatively but with no improvement, and in June 1939 right lower lobe was resected, when a caseous mass with cavitation was found to occupy the upper part of the lobe. Three years later she is well. Commenting on the case the authors state "The hilar tuberculous lesion is the step-child of surgical collapse therapy; disappointing results are likely to be obtained with any or all forms of treatment"

More recently further work in this field has been reported. Thus, James removed three lower lobes for persistent tuberculous cavitation. In two of these artificial pneumothorax had been contraselective, and in the third artificial pneumothorax led to ballooning of the cavity. Two of these cases developed secondarily infected tuberculous empyemata with bronchial fistula, with one death. In view of this James concluded "The death following excision of a relatively acute tuberculous lesion of the lower lobe suggests that the operation should be undertaken only upon relatively stabilised lesions".

Overholt and Wilson have recently reported their results in a series of 61 patients in whom 35 pneumonectomies and 28 lobectomies had been performed. Among the latter were 7 cases of basal pulmonary tuberculosis, and the results in these are set out in Table 14. Resection was the initial treatment in two of these cases: two had failed to respond to pneumothorax: another two had not benefited from phrenicectomy alone, and the remaining case had had pneumothorax and phrenic crush without effect.

TABLE 14

See next page/

TABLE 14

Case	Age	Sex	Sputum	Duration of disease Yrs.	Mths.	Side	Previous treatment	Operation Date	Complications	Sputum at Present	Present clinical state.
M.S.	26	F	Plus	-	2	Left	Phrenic Crush	14.5.42	Nil	Negative	Well
D.B.	26	F	Plus	-	3	Right	Pneumo-thorax	15.5.42	Spread to right upper lobe	Positive	Had R.U. & M. Lobectomy in January, 1944.
J.G.	28	F	Plus	2	6	Right	Nil	18.6.42	Spread to R.M. & upper lobes	Positive	Had R.U. & M lobectomy 13th April, 1943.
M.G.	29	F	Plus	1	3	Right	Phrenic	25.8.42	Nil	Positive	Clinically well.
E.C.	25	F	Plus	-	3	Left	Nil	23.10.42	Contra-lateral spread.	Negative	Well
M.A.	34	F	Nil	3	0	Right	Phrenic & Pneumo-thorax.	26. 4.43	Nil	Negative	Well
M.D.	33	F	Plus	6	0	Left	Phrenic	20. 5.43	Nil	Positive	Clinically well.

These results are not wholly discouraging, and while not advocating this radical therapy as primary treatment, it would appear reasonable to consider this in a case where all other methods have failed, provided the lung lesion has remained localised and the general condition of the patient is good.

Comparison with results obtained in treatment of 'Apical' Cases.

For this I have used the immediate results of treatment obtained in 100 'typical' cases discharged consecutively from Clare Hall County Hospital in 1944. I have confined the comparison to basal cases treated in the same Hospital, and these figures are set out in Table 15

TABLE 15

See next page/

Though figures involved are small it appears that the immediate results of modern therapy in basal cases compares favourably with those obtained for the more common type of lesion.

TABLE 15

Treatment	No. Treated 'Typical'	No. Treated 'Basal'	Classification on Admission 'Typical' +1	'Typical' +2	'Typical' +3	'Basal' +1	'Basal' +2	'Basal' +3	Quiescent on Discharge 'Typical'	Quiescent on Discharge 'Basal'	Non-Quiescent on Discharge 'Typical'	Non-Quiescent on Discharge 'Basal'	Died 'Typical'	Died 'Basal'	Treating 'Typical'	Treating 'Basal'
Rest	12	6	2	8	2	1	2	3	5	4	7	2	-	-	-	-
Phrenic	8	7	7	1	0	4	3	0	8	4	0	2	0	1	-	-
Artificial Pneumothorax	19	12	2	15	2	1	11	0	16	10	2	2	1	0	-	-
Bilateral Artif. Pneumothorax.	8	7	0	7	1	0	5	2	6	6	2	1	0	0	-	-
Artif. Pneumothorax & Phrenic	19	37	4	13	2	8	26	3	17	29	2	4	0	4	-	-
Phrenic & Pneumo-peritoneum	16	13	4	8	4	2	10	1	8	10	8	2	0	1	-	-
Phrenic, Pneumo-peritoneum & A.P.	14	14	0	13	1	2	12	0	11	14	3	0	0	0	0	-
Thoracoplasty	2	0	0	2	0	0	0	0	1	0	1	0	0	0	0	-
Thoracoplasty & A.P.	1	1	0	1	0	0	1	0	1	0	0	0	0	0	-	1
Right Extra-pleural Pneumothorax & A.P.	1	0	0	1	0	0	0	0	1	0	0	0	0	0	-	-
Rib Resection	0	1	0	0	0	0	1	0	0	1	0	0	0	0	-	-
Refused treatment	0	1	0	0	0	0	1	0	0	0	0	1	0	0	-	-
Phrenic, Pneumo-peritoneum with contra-lat. A.P.	0	1	0	0	0	0	1	0	0	1	0	0	0	0	-	-
TOTALS:	100	100	19	69	12	18	73	9	74	79	25	14	1	6	0	1

C O N C L U S I O N S.

1. Basal tuberculosis cannot be regarded as an occasional atypical occurrence for the following reasons:
   a) The incidence of this type of lesion in this series comparable with the incidence noted by other investigators.
   b) Right-sided lesions predominate and the level of the lesion in the lung field is fairly uniform.
   c) A higher incidence in females is a constant finding.
2. The onset of the disease tends to be acute - pleural pain and haemoptysis being noteworthy early symptoms.
3. Radiologically the lesions are in the main soft in character, and early cavitation and early spread are features.
4. Why Tuberculosis should develop in this atypical site has given rise to much speculation. While available evidence points to impaired diaphragmatic movement being responsible for such localisation of the disease, it is suggested that in some cases the lesions represent a progression of a primary tuberculous infection.
5. The results obtained in cases treated by preparatory Phrenic and pneumoperitoneum are encouraging, and suggest that this should be the initial form of active therapy for basal lesions. It is recommended that this form of collapse be replaced where possible by artificial pneumothorax, but control of the disease by maintaining pneumoperitoneum can be expected in a proportion of cases in whom subsequent artificial pneumothorax fails, or by reason of indivisible adhesions cannot be made effective. Published results to date do not appear to support the claim that A.P. is the best initial treatment for this type of lesion. Most investigators agree that it is unsafe to treat basal lesions on bed rest alone, and findings in the present investigation lends support to this view.
6. The immediate prognosis for the atypical case compares favourably with that of the more common type of lesion, provided treatment is active, adequate, and instituted early.

SUMMARY.

1. A brief review of the relevant literature has been given to show gradual recognition of the atypical form of pulmonary tuberculosis.

2. 139 cases representing an incidence of 3% have been investigated.

3. The salient clinical and radiological features are indicated.

4. In the differential diagnosis the importance of sputum examination is stressed, and a reliable method for culture of tubercle bacilli is described.

5. Probable factors in the etiology of this condition noted.

6. Cases have been treated by:

1.	Rest alone	
2.	Artificial Pneumothorax)	
3.	Phrenicectomy)	alone or in
4.	Pneumoperitoneum)	combination.
5.	Thoracoplasty)	

7. The technique for pneumoperitoneum induction is outlined, and the adoption of a method, not previously described, which introduces safety in refills is advocated.

8. The results of therapy have been analysed with a view to determining the most effective method or combination of methods of treatment for this type of lesion.

9. X-ray films have been reproduced, and used to illustrate appropriate points in the context.

10. Details of cases referred to in this thesis are noted in the Appendix.

BIBLIOGRAPHY.

ALEXANDER, H. (1926) Beitr. z. Klin d. Tuberk. 62. 318.

ANDOSCA, J.B. & FOLEY, J.A. (1943) J. Thoracic Surgery. 12. 259.

ASSMANN, H. (1923) Beitr. z. Klin d. Tuberk. 60. 526.

BANYAI, A.L. (1934) Am. Rev. Tuberc. 29. 603.

BERNARD, L. (1930) Presse Med. 38. 373.

BUSBY, L.F. (1939) Am. Rev. Tuberc. 40.

BROCK, R.C. (1938) Brompton Hospital Reports.

BROOKS, W.D.W. (1938) Brit. J. Tuberc. 32. 14.

CHURCHILL & KLOPSTOCK (1943) Annals of Surgery. 117. 641.

COHEN, R.C. (1945) Brit. Med. J. p.662.

COLTON, W.A. (1928) U.S. Vet. Bur. M. Bull. 40. 503.

CONSTANTINI, G. (1929) Riv. di Pat. e Clin de Tuberc. 5. 394.

DAVIDSON, M. (1941) "A Practical Manual of Diseases of the Chest".

DESSERIER, J.T. (1931) "Etude sur les Cavernes Tub. de la Region Hilaire". These de Paris.

DURHAM, K & NORTON, V.V. (1927) J.A.M.A. 89. 1573.

FABER, K. (1931) Acta Med. Scandinavica 75, 403.

FAGGE, C.H. (1929) Principles and Practice of Medicine p.361.

FOWLER, (1888) "The Localisation of Lesions in Phthisis".

FOWLER, W.D. (1941) Am. Rev. Tuberc. 44. 474.

FREEDLANDER, S.D. (1938) J. of Thor. Surg. 7. 455.

FREMMEL, F. (1937) Am. Rev. Tuberc. 36. 488.

GORDON. B. (1936 March) International Clinics $\frac{\cdot}{1}$ 46th Series.

GORDON, W.A & CHARR, R. (1933) M. Clin. N. America 17. 727.

HAMILTON, C.E. & FREDD, H. (1935) J.A.M.A. 105. 427.

JAMES, R.M. (1945) J. of Thor. Surg. 14. 3.

JONES & MACDONALD (1943) 'Tubercle' 24. 97.

KAYNE, G.G. et Alia (1939) "Pulmonary Tuberculosis" p.235.

KEITH, Sir. A. (1909) Further Advances in Physiology p.182. London.

KIDD, P. (1886) 'Lancet' 2. 615 & 665.

KUGELMEIER, L.M. (1935) Beitr z Klin d Tuberk. 87. 262.

LAENNEC, R.T.M. (1925) "A Treatise on Diseases of Chest and on Mediate Auscultation" translated by J.FORBES.

LAIRD, R. (1945) 'Tubercle' September - October. 149.

BIBLIOGRAPHY (Continued).

LANDIS, H.R.M. (1921) "Diseases of the Chest".

LAYTHROP, A.S. & LYMAN, D.R. (1924) Tr. Am. Climat. & Clin A. 40. 166.

LLOYD, W.E. (1940) 'Practitioner' 144. 482.

MAXWELL, J. (1938) Introduction to Diseases of the Chest p.234.

OVERHOLT, R.H. & WILSON N.J. (1945) J. of Thor. Surg. 14. 55.

REICHE (1902) Ztschr. d Tuberk. 3. 223. quoted by FISHBERG (1932) Pulmonary Tub. Vol. 1 p.277.

REISSNER, D. (1935) Arch. Int. Med. 61. 258

RILANCE,A.B. & WARRING, F.C. (1941) Am. Rev. Tuberc. 44. 323.

RILANCE,A.B. & WARRING, F.C. (1944) ibid. 49. 353.

ROSS, E.L. (1930) Canadian M.A.J. 22. 347.

SAGONA, L. (1931) Riv. di Pat. e Clin de Tuberc. 9. 758.

SIMMONDS, F.A.H. (1945) In Press.

STEEN, P. (1945) Brit. J. of Tuberc. 39. 3.

STUERTZ (1911) Quoted by Kayne et alia. Pulmonary Tuberculosis p.353.

SWEANY et Alia. (1931) Am. Rev. Tub.

TORNING, K. & SPRINGBORG, A. (1939) Acta Tub. Scandinavica 13. 3 - 4.

TURNER, R.W.D. (1945) 'Lancet' 16. 493.

VADJA, L. (1933) Ztschr. d. Tuberk. 67. 391.

VISWANATHAN, R. (1936) Brit. Med. J. 2. 1300.

WEIDMANN, W.H. & CAMPBELL, H.B. (1937) Am. Rev. Tuberc. 36. 525.

WESSLER, H. (1923) "Clinical Roetgenology of Diseases of the Chest" TROY.

A P P E N D I X.

CASE NO. 1 Male age. 19. Munition Worker.

Transferred to Sanatorium July, 1942.

History: Small haemoptysis January 1942. Following chest x-ray admitted to Thoracic Unit for investigation (See Figure I) Sputum T.B. Negative on direct examination. Bronchoscopic examination on 23rd January 1942 revealed pus discharging from dorsal branch right lower lobe, and this on direct examination found to be T.B. Negative. Diagnosis of lung abscess made, and surgical drainage instituted by two-stage operation on 29th January, 1942 and 12th February, 1942. Biopsy of material removed at second stage operation proved the lesion to be tuberculous.

State on Transfer: Acutely ill. Swinging temperature 99/102°F. There was scanty sero-purulent discharge from sinus in chest wall. Clinical and radiological findings suggested the presence of a massive right pleural effusion, and on exploration thick pus found. This on culture grew Staphylococcus Aureus and tubercle bacilli.

Treatment: Efficient closed under water drainage was established after resecting portion of 9th rib. Convalescence was protracted, but re-expansion of the lung was obtained, and he was discharged well on 3rd April, 1943.

Present state: Alive, well and working. A recent x-ray shows some residual pleural thickening on right side, but lung lesion remains quiescent.

Comment: Resort to special methods of sputum examination, viz: concentration and culture, might have in this case avoided an error in diagnosis.

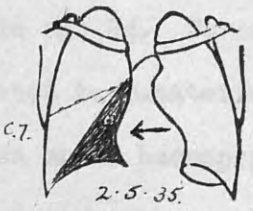
CASE NO.2 Male age 24. Clerk.

Admitted to Sanatorium, April, 1935.

History: Cough with scanty sputum of four months duration. Some loss of weight.

State on Admission: General condition fair. Temperature 98/101°F. Blood Sed. Rate 30/70. Sputum T.B.Positive.

X.Ray:



Treatment: Bed Rest
Right A.P. July, 1935.

A few days after induction, onset of acute empyema necessitating transfer of case for surgical drainage.

Follow-up: Reveals that spread of tuberculous disease occurred to contra-lateral lung, and progress was rapidly downhill.

Comment: Original x-ray picture in this case the interesting feature.

CASE NO.3 Female. age 21. Housewife.

Admitted to Sanatorium September, 1942.

History: Small haemoptysis January, 1942. Chest x-ray at this time showed area of soft mottling right lower zone. Pulmonary tuberculosis suspected. One month later lesion had progressed and cavitation was obvious. Sanatorium treatment recommended, but this refused until September, 1942.

State on admission: General condition good. Temperature 98/99.4°F. Blood Sed. Rate 48/84. Sputum T.B. Positive. X-Ray now showed that there had been a spill-over and cavitation was definite in both lower zones.

Treatment: Bed rest
Right artificial pneumothorax induced October, 1942.
Right phrenic evulsed December, 1942.

In spite of what appeared to be a free right artificial pneumothorax cavitation persisted and was little affected by/

by rise of dome following phrenic evulsion. Disease slowly progressed to involve all zones both lungs, and progress was steadily downhill.

Comment: This case demonstrates cavitation occurring early in the basal type of lesion.

CASE NO. 4 Female age 24. Nurse.

Admitted to Sanatorium January, 1939.

History: Sudden small haemoptysis while on duty. Had been nursing for two months on the Sanatorium staff and Mantoux test known to be negative.

State on Admission: General condition good. Slight cough, but no sputum. Febrile to 99°F evening.

X-ray of chest showed area of soft mottling left mid zone.

Treatment: Bed rest

Lesion progressed to definite cavitation within a month, and left artificial pneumothorax induced February, 1939. On discharge in October, 1939 disease considered quiescent.

Present state: Attending for refills as an out patient for three years. Two years later she was alive, well and working.

Comment: It is more than likely that this nurse's lung lesion was a result of a progressive primary infection. Also illustrative of cavitation occurring early in this type of case.

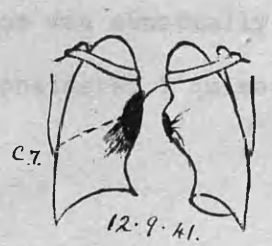
CASE NO. 5 Male age 16 Apprentice Fitter.

Admitted to Sanatorium 12th September, 1941.

History: Non-productive cough persisting after influenzal cold. Following x-ray of chest admitted to Hospital, and two months later transferred to Sanatorium.

State on admission: General condition good. Afebrile Blood sed. Rate 2/6mm. Cough slight and non-productive.

X-ray of Chest:



Treatment/

Treatment: Bed Rest.

Bronchoscopy on 23rd January, 1942 revealed a mass in main bronchus. Treatment conservative for two months, then cough became productive. Sputum T.B. Positive, and x-ray showed fresh soft mottling with early cavitation right lower zone.

Right phrenic crush 3rd March, 1942: failed to control the disease.

Right Artificial Pneumothorax induced 10th June, 1942.

Discharged 21st November, 1942 - lung lesion quiescent.

Present state: Right artificial pneumothorax maintained. patient well and working.

Comment: X-ray and bronchoscopic findings originally those of primary infection with massive hilar gland enlargement. Later a bronchogenic spread occurred to right lower lobe which became the seat of adult phthisis.

CASE NO.6. Female age 22 Housewife

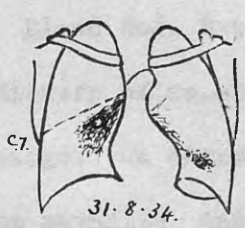
Admitted September, 1934.

History: Admitted following sudden haemoptysis.

State on admission: General condition good. 98/99°F (temperature)

Blood sedimentation rate 9/22mm. Sputum a trace T.B.Positive.

X-ray of chest:

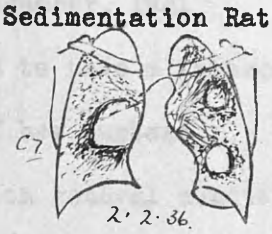


Treatment: Conservative.

On discharge June, 1935 general condition good. No cough or sputum, and radiologically cavitation no longer obvious. Blood sedimentation was abnormally rapid 33/60mm, and lung lesion was considered ? quiescent.

Readmitted/

Readmitted: February 1936 in poor general condition. Temperature 98/100°F. Blood Sedimentation Rate 60/96 mm. Larynx involved. X-ray of chest:



Treatment: Considered too advanced for any form of therapy, and on discharge in June her condition was worse. She died October, 1936.

Comment: Patient appeared to do well on conservative treatment, but clinical relapse with rapidly progressive disease took place a few months after discharge from Sanatorium.

CASE NO.7 Female age 23 Domestic.

Admitted August, 1937.

History: Cough with sputum of two months duration.

State on Admission: General condition fair. Temperature 98/99° Blood Sed. Rate 25/40 mm. Sputum T.B.Positive.

X-ray showed soft mottling with obvious cavitation in right lower zone. Left lung clear.

Treatment: Conservative.

Discharged in February 1938. General condition good. She had regained lost weight. Had no cough or sputum, and radiologically there was much resolution, and cavitation no longer obvious. Blood Sed. Rate remained raised at 16/34mm.

Follow-up: Subsequent history of re-activation of disease within six months of discharge. On admission to a Sanatorium one year later condition advanced, and collapse therapy contra-indicated. She died June, 1942.

Comment: Relapse within a short time of discharge from Sanatorium where chest lesion appeared to do well with conservative treatment.

CASE NO.8. Female age 31 Housewife.

Admitted December, 1941

History: Discovered to have a tuberculous lesion when x-rayed as a contact of her husband.

On admission general condition good. Afebrile. Had no cough or sputum, but laryngeal swab culture T.B.Positive. X-ray 16th December, 1941 showed right lung clear. Left lung - localised area of mottling in lower zone.

Treatment: Bed rest.

Left phrenic crush 13th February, 1942.

On discharge in June, 1942 disease was considered quiescent.

Subsequent History: Patient remained well and under dispensary supervision until November, 1943, when T.O. reported - "Renewed activity in old lesion".

On re-admission January 1944 her general condition was good, but cough and sputum T.B.Positive, were now present.

Blood Sedimentation Rate 27/50mm.

X-ray showed right lung still clear, and definite increase of mottling in left lower zone with early cavitation.

Treatment: Bed rest.

Left artificial pneumothorax induced July, 1944.

The collapse, which appeared a free one, was complicated early by a clear effusion (Eosinopils 54%, Polymorphs 26%, Monocytes 26%, Lymphocytes 4%), which was sterile on culture.

Obliterative pleurisy lead to abandonment of Artificial Pneumothorax August, 1944.

Left Phrenic re-crushed 17th August, 1944.

On discharge in October, 1944 lung lesion appeared quiescent. Laryngeal swab negative on culture. Blood sed. Rate 5/12mm.

Comment: This case demonstrates the relative instability of this type of lesion.

CASE NO.9. Female age 29 Housewife.

Admitted 22nd January, 1940.

History: Cough of two months duration. Haemoptysis led to having chest x-rayed. Pulmonary tuberculosis diagnosed. Sputum T.B. Plus. Admitted to General Hospital and had 13 weeks bed rest prior to transfer to Sanatorium.

On admission to Sanatorium general condition fair. Temperature 98/99°. Blood Sedimentation Rate 38/70. Sputum: one ounce, T.B.Plus.

X-Ray 23/1/40 showed - Right: Mottling in mid zones.

Left: Mottling mid and lower, with obvious cavitation at hilum level.

Treatment: Bed rest for four months.

Left A.P. induced 12/2/46, but collapse could not be made selective, at thoracoscopy owing to indivisible adhesions.

Left phrenic crush 11/3/40.

Fluid occurred as an early complication. Following aspiration re-expansion of lung was achieved.

On discharge 9/7/40 disease was un-controlled.

Present state: Alive, but far from well, and disease advanced.

CASE NO.10. Female age 20 Housewife.

Admitted 30th April, 1943.

History: Found to have pulmonary tuberculosis as a result of contact examination.

On admission general condition good, temperature 98/99°F Blood sedimentation rate 26/55mm. Cough troublesome, and sputum T.B.Plus.

X-Ray 3/5/43 showed - Right: Clear.

Left: Mottling mid and lower zones, with cavitation at hilum level. See Figure V.

Treatment: Bed Rest

Left Artificial Pneumothorax 26/5/43.

Adhesion/

Adhesion Section 15/6/43.

Complicated by tuberculous empyema 23/7/43. With aspirations complete re-expansion of left lung occurred by June, 1944. At this time spread of disease occurred to right upper zone, in which a right Artificial Pneumothorax was induced 22/8/44, and a free A.P. obtained by adhesion section 18/9/44.

On discharge16/3/45 general condition good. Afebrile. Blood sedimentation rate 4/12mm, and laryngeal swab negative. Disease considered quiescent, and right A.P. maintained.

Present state: Has remained well, and disease appears controlled.

CASE NO. II Male Age 22 Factory Worker.

Admitted 22nd August, 1941.

History: Haemoptysis while at work. Chest x-rayed, and pulmonary tuberculosis diagnosed.

On admission: General condition good. Temperature 98/99. Blood sedimentation rate 20/43. Cough with trace of sputum T.B.Plus.

X-ray: 25/8/41 showed - Right: Mottling mid and lower zones, with definite cavity at hilar level.

Left: Appeared clear.

Treatment: Bed rest for two weeks.

Right Artificial Pneumothorax induced 5/9/41.

Right Phrenic Crush 3/10/41.

Pleural effusion as a complication began November, 1941. Fluid at first clear. Later became turbid and T.B.Plus. With regular aspiration re-expansion of lung occurred over a period of ten months.

On discharge 17/7/43 general condition good. Afebrile, free from cough and sputum. Laryngeal swab negative. Blood sedimentation rate 10/32. Re-expansion of right lung was complete, and little pleural thickening partly obscured lung field. No obvious cavitation could be made out.

Present state: Alive, well and working, and recent x-ray shows disease remains healed.

CASE NO.12 Male Age 21 Factory worker.

Admitted January, 1941.

History: Admitted to Hospital (Southampton) May, 1939 following sudden haemoptysis.

X-ray 31/5/39 showed - Right lung: Clear.

Left lung: Area of soft mottling left lower zone, close to heart border. Obvious cavitation present, partly retro-cardiac in position.

Sputum at this time T.B.Plus.

Left Artificial Pneumothorax induced June, 1939. No adhesion section performed, and fluid occurred as an early complication. He had frequent aspirations, and A.P. was maintained. Later evacuated to own home, and shortly afterwards to Winsley Sanatorium.

On admission: General condition poor. Temperature to 99°F. Blood sedimentation rate 25/60mm. Found to have a left tuberculous pyo-pneumothorax.

Treatment: After regular and prolonged aspirations re-expansion of left lung occurred.

On discharge November, 1943 general condition was good. He was afebrile. Blood sedimentation rate 3/8mm. Scanty mucoid sputum - T.B. culture negative. Disease considered quiescent.

Present state: Alive, well, and working.

CASE NO.13 Female Age 22 Factory Hand.

Admitted 23rd April, 1941.

History: Cough four months duration. Referred to T.O. and pulmonary tuberculosis diagnosed.

On admission: General condition poor. Temperature 98.4/100°F. Blood sedimentation rate 29/64. Sputum T.B.Plus

X-Ray: February 1941, showed - Right side: Soft mottling mid and lower zones, with obvious cavitation hilum level.

Left side: clear.

Treatment: Bed rest

Right Artificial Pneumothorax 4/3/41 in General Hospital prior to admission to Sanatorium.

Adhesion Section 5/5/41 - free collapse obtained.

Cavity persisted, so collapse supplemented by right Phrenic crush on 13/5/41.

Right phrenic nerve evulsed 28/7/41.

Cavity remained patent, and acute effusion - T.B. Plus - occurred 12/9/41.

Artificial Pneumothorax abandoned November, 1941.

On discharge 9/4/42 general condition fairly good. Afebrile. Blood sedimentation rate 8/20mm. Trace of sputum negative on culture for tubercle bacilli.

X-ray 2/4/42 showed - Right side: Dome of diaphragm high in position. Much pleural thickening obscuring lung field. No definite cavity could be made out.

Left side: remained clear.

Present state: Alive and well.

Recent x-ray shows considerable calcification in right lower zone. Left lung remains clear.

Commentary on Cases 9/13 : Pleural effusion a likely complication of artificial pneumothorax therapy when this is induced in the toxic case.

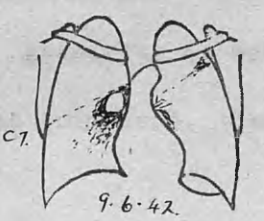
CASE NO.14. Female Age 32 Housewife.

Admitted 12/8/42.

History: Illness began with acute right pleural pain, and on account of this referred for x-ray of chest. Just prior to admission small haemoptysis.

On admission: General condition fairly good. Temperature 98/99°F. Blood sedimentation rate 25/60mm. Sputum T.B.Plus

X-Ray:



Treatment: Bed Rest.

Right phrenic crush 15/9/42.

Pneumoperitoneum induced 30/9/42.

Right artificial pneumothorax induced 13/1/43

Adhesion Section 12/2/43.

Effective free A.P. obtained, and pneumoperitoneum abandoned from 11th March, 1943.

On discharge 25/3/43 general condition good. Afebrile. Laryngeal Swab negative on culture. Disease quiescent.

Present state: Right artificial pneumothorax maintained. Alive well and working.

CASE NO. 15. Female Age 28 Factory Worker.

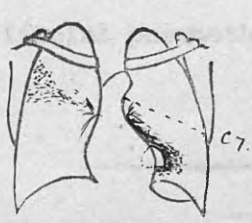
Admitted 14/4/42.

History: Cough with sputum since January 1942.

On admission: General condition poor. Temperature 98/100°.

Blood sedimentation rate 45/78. Sputum T.B.Plus.

X-Ray:



Treatment: Bed rest for two months.

Left phrenic crush 9/6/42

Pneumoperitoneum 20/7/42 abandoned 19/4/43.

Right Artificial Pneumothorax induced 7/10/42.

Right Adhesion Section 23/10/42 - free collapse obtained.

Left artificial pneumothorax induced 12/5/43.

Left adhesion section 15/6/43 - free collapse obtained.

On discharge 22/4/44 general condition good. Blood sedimentation rate 6/14mm. Disease controlled by effective bilateral artificial pneumothorax.

Present state: Attending as out-patient for A.P. refills. Disease remains quiescent. Patient is working.

CASE NO. 16 Female Age 22 Factory worker

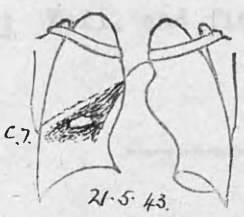
Admitted 2/8/43.

History: Cough of two months duration.

On admission: General condition good. Temperature 97.4/99°F.

Blood sedimentation rate 38/77mm. Sputum T.B.Plus.

X-ray:



Treatment: Bed rest for four weeks

Right phrenic crush 26/8/43

Pneumoperitoneum 26/9/43 abandoned 13/12/43

Right artificial pneumothorax induced 14/12/43.

Right adhesion section 3/2/44.

On discharge 29/6/44 general condition good. Afebrile, Blood sedimentation rate 8/18mm. Disease under control by effective right artificial pneumothorax.

Present state: Artificial pneumothorax maintained. Patient well and working.

CASE NO. 17. Female Age 37 Housewife.

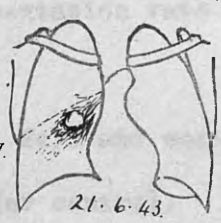
Admitted 17/8/43.

History: Pulmonary tuberculosis diagnosed following x-ray as contact.

On admission: General condition fair. Temperature 98/99.4°F

Blood sedimentation rate 26/50mm. Sputum T.B.Plus.

X-Ray:



Treatment: Bed rest

Right phrenic crush 14/9/43.

Pneumoperitoneum 17/9/43.

Right Artificial Pneumothorax 18/11/43.

Thoracoscopy/

Thoracoscopy 16/12/43 - no adhesions found.

On discharge 29/6/44 general condition good. Afebrile, Blood sedimentation rate 8/20mm. Disease considered quiescent, and under control by right artificial pneumothorax and pneumoperitoneum, which were maintained.

Present state: Well, and fit to do own housework. Disease remains quiescent.

CASE NO. 18. Female Age 19 Factory hand.

Admitted 5th May, 1944.

History: Febrile at onset of illness, and treated by own Doctor as pneumonia. Temperature persisted. Cough became troublesome. Sputum tested and found T.B.Plus.

On admission: General condition poor. Temperature 99/100°F. Blood sedimentation rate 64/100mm. See Figure VI.

Treatment: Bed rest

Right phrenic crush 16/5/44

Pneumoperitoneum 18/5/44

Right artificial pneumothorax 14/8/44

Right adhesion Section (1) 15/9/44

(2) 30/10/44

(3) 6/12/44.

Completely free A.P. impossible owing to a few indivisible gutter adhesions, but A.P. appeared effective following pneumoperitoneum abandonment.

On discharge 27/2/45 general condition good. Afebrile, Blood sedimentation rate 5/10mm. Laryngeal Swab negative on culture.

Present state: Well and working. A.P. maintained. Disease remains under control.

CASE NO.19 Female Age 15 Factory worker.

Admitted 27th August, 1944.

History/

History: Sudden haemoptysis. Referred for x-ray, and pulmonary tuberculosis diagnosed. Admitted to General Hospital, and later transferred to Sanatorium.

On admission: General condition good. Temperature occasionally to 99°F.

X-ray - see Figure VII.

Treatment: Bed rest.

Left phrenic crush 29/5/44

Pneumoperitoneum induced 4/6/44

Left artificial pneumothorax induced 28/8/44

Free collapse obtained 19/9/44 by adhesion section.

On discharge 16/1/45 general condition excellent. Blood sedimentation rate 2/7mm. Laryngeal swab negative on culture. Disease quiescent.

Present state: Left artificial pneumothorax maintained, and patient well and working.

CASE NO. 20. Female Age 37 Housewife.

Admitted 31st December, 1943.

History: Referred for x-ray of chest following small haemoptysis. One year previously x-rayed as contact of husband, and chest reported clear.

On admission: General condition good. Temperature 97/99°F. Blood sedimentation rate 40/93mm. Sputum T.B.Plus.

X-ray:

Treatment: Bed rest

Right phrenic crush 22/2/44

Pneumoperitoneum induced 12/4/44

Right artificial pneumothorax induced 8/8/44

Right/

Right adhesion section 10/11/44 - free collapse not obtained owing to a few indivisible gutter adhesions.

Pneumoperitoneum, which was abandoned at time of Artificial Pneumothorax induction was reinduced on 14/12/44 when it was found that original cavity had re-opened.

On discharge 27/4/45 general condition good. Afebrile. Blood sedimentation rate 3/8mm. Laryngeal Swab negative on culture. Disease under control. Right artificial pneumothorax and pneumoperitoneum maintained.

Present state: Well and working. Disease remains quiescent. Artificial Pneumothorax and pneumoperitoneum maintained.

CASE NO.21. Female Age 15 Scholar.

Admitted 30th October, 1944.

History: Discovered to have pulmonary tuberculosis when x-rayed as contact of mother.

On admission: General condition good. Temperature occasionally to 99°F. Blood sedimentation rate 22mm. Sputum T.B.Plus.

Treatment: Bed rest

Phrenic Crush (Right) 23/11/44

Pneumoperitoneum 4/12/44

Right Artificial Pneumothorax 30/1/45

Adhesion Section 27/3/45 - free collapse obtained.

On discharge 17/8/45 general condition good. Afebrile. Blood Sedimentation Rate 4/10mm. Laryngeal Swab negative on culture.

Present state: Well and working. Right artificial pneumothorax maintained.

CASE NO.22. Female Age 23 Clerkess.

Admitted 18th August, 1944.

History: Haemoptysis September, 1943. Later developed cough with/

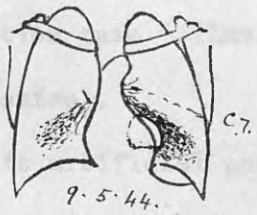
with sputum May, 1944. Referred for x-ray of chest.

Admitted to General Hospital where she was in bed for two months.

On admission: General condition good. Temperature 98/99.8°F.

Blood Sedimentation Rate 23mm. Sputum T.B.Plus.

X-ray:



Treatment: Bed rest.

Pneumoperitoneum 7/9/44 - abandoned January, 1945.

Left artificial pneumothorax induced 16/10/44.

Left adhesion section 14/11/44.

Right artificial pneumothorax 30/1/45.

Right adhesion section 27/3/45.

On discharge 15/5/45 general condition good. Afebrile. Blood sedimentation rate 5/13mm. Laryngeal Swab negative on culture. Disease under control.

Present state: Well and working. Bilateral Artificial Pneumothorax maintained.

CASE NO.23. Female Age 29 Housewife.

Admitted 17/1/45.

History: Cough and sputum of two months duration. Small haemoptysis prior to admission.

On admission: General condition fairly good. Temperature 97.4/99°.

Blood sedimentation rate 38/62mm. Sputum T.B.Plus.

X-ray 21/11/44 - Right side: Scanty mottling mid zone.

Left side: Soft mottling lower zone, with obvious cavity at hilar level.

Treatment: Bed rest for two months, in General Hospital prior to admission.

Left phrenic crush 8/2/45.

Pneumoperitoneum induced 21/2/45.

Left/

Left artificial pneumothorax 29/5/45.

Left adhesion section 2/7/45.

Left phrenic re-crush 22/8/45.

On discharge in December general condition good. Afebrile. Blood sedimentation rate 5/11mm. Laryngeal Swab negative on culture. Disease under control.

Present state Left artificial pneumothorax and pneumoperitoneum maintained.

CASE NO. 24. Male Age 23 Factory hand.

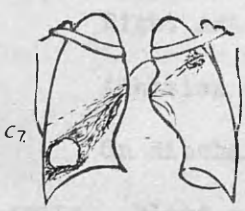
Admitted 21/1/44.

History: Haemoptysis while at work two months prior to admission. Referred to T.O. on account of this and pulmonary tuberculosis diagnosed.

On admission: General condition good. Temperature 97/99°.

Blood sedimentation rate 23/50mm. Sputum T.B.Plus (One ounce).

X-ray:



Treatment: Bed rest.

Phrenic Crush (Right) 15/2/44.

Pneumoperitoneum induced 27/3/44.

Right Artificial Pneumothorax 17/5/44.

Free collapse obtained.

On discharge 14/10/44 general condition excellent. Blood sedimentation rate 2/9mm. Laryngeal Swab negative on culture.

X-ray 12/10/44 - Right side: Free artificial pneumothorax.

Left side: Mottling in upper zone scanty and hard.

Present state: Right A.P. maintained. Patient well.

CASE NO.25 Male Age 26 Dental Mechanic.

Admitted 12th April, 1943.

History:/

History: Sudden onset of pleural type of pain in right side of chest. Irritating cough first noted a few days later, persisted, and soon became productive. Diagnosed as pulmonary tuberculosis following x-ray. Sputum became T.B.Positive.

On admission: General condition fair. Temperature 97/99°F. Blood sedimentation rate 50/95mm. Sputum T.B.Plus.

X-ray: 12/4/43 showed - Right side: Area of soft mottling extending from hilar region to lower zone. Cavitation obvious.

Left side: Scanty mottling in mid zone.

Treatment: Bed rest

Right phrenic crush 4/5/43

Pneumoperitoneum 10/7/43

Right Artificial Pneumothorax 10/10/43.

Adhesion Section 11/12/45 - free A.P. obtained.

On discharge 22/1/44 general condition good. Afebrile. Blood sedimentation rate 7/20mm. Laryngeal swab negative on culture.

X-ray: Right side: Free artificial pneumothorax. Cavitation no longer obvious.

Left side: Appears clear.

Present state: Well and working. Right A.P. maintained. Disease remains quiescent.

CASE NO. 26 Male Age 26 Sailor.

Admitted 21st December, 1942.

History: Discovered by mass radiography while on service. Four months in Naval Hospital prior to admission to Sanatorium.

On admission: General condition good. Temperature occasionally to 99°F. Blood sedimentation rate 13/30mm. Sputum T.B.Plus.

X-ray: 22/12/42 /

X-ray: 22/12/42 - showed - Right side: Soft mottling, and definite cavity lower zone.

Left: Scanty mottling in upper zone.

Treatment: Right phrenic crush 22/1/43

Pneumoperitoneum induced 25/2/43.

On discharge (emergency) 15/5/43, general condition improved. Blood sedimentation rate 7/18mm. Afebrile. No sputum.

X-ray at this time showed right lower zone cavity apparently closed.

Follow up: Attended as out-patient for refills. Unwilling to be readmitted for right artificial pneumothorax, but accepted re-crush of right phrenic nerve 23/10/43. Pneumoperitoneum maintained, but later Laryngeal Swab found T.B.Plus, and after much persuasion agreed to be readmitted.

Further treatment: Right Artificial Pneumothorax 16/10/45

Right Thoracoscopy 15/11/45 - no adhesions found.

Recently discharged, pneumoperitoneum having been abandoned, and disease now under control by free right artificial pneumothorax.

Commentary on Cases 14/26: Cases showing definite general and radiological improvement following Phrenic and Pneumoperitoneum. This would appear to prepare the patient for relatively safer artificial pneumothorax therapy.

CASE NO. 27. Male Age 32 Clerk.

Admitted 12/6/44.

History:/

History: Cough of six months duration. Haemoptysis prior to admission.

On admission: General condition fair. Temperature 98/99.4°F. Blood sedimentation rate 21/46mm. Sputum T.B.Plus.

X-ray: 12/6/44 - Right: Soft mottling mid zone. Cavitation suspected.

Left: Mottling mid and lower zones, with cavity at hilar level.

Treatment: Bed rest

Bronchoscopy 20/6/44 - N.A.D.

Pneumoperitoneum induced 27/6/44.

Left artificial pneumothorax 11/1/45.

Left adhesion section 8/2/45: free collapse obtained.

Right artificial pneumothorax 11/4/45.

Right adhesion section 11/5/45. (1)

29/6/45 (2) - free collapse obtained.

On discharge, November, 1945, general condition good. Afebrile. Laryngeal swab negative on culture. Bilateral artificial pneumothorax maintained.

Comment: Following control of disease on left by free Artificial Pneumothorax disease in right mid zone softened, and second artificial pneumothorax necessary. A good result from non-selective pneumoperitoneum.

CASE NO.28. Male Age 27 Soldier.

Admitted 13th September, 1944.

History: Febrile illness with pleural type of pain right chest while on service. Repatriated to U.K. May 1944 and admitted to Preston Hall. Later transferred to Clare Hall.

On admission: General condition good. Afebrile. Blood sedimentation rate 11/32mm. Sputum T.B.Plus.

X-ray: 13/9/44 showed - Right side: Area of dense mottling in cardio-phrenic angle. Costo-phrenic angle appeared/

appeared obliterated.

Left side: Clear.

Right lateral of same date showed obvious cavitation posteriorly in the lower lobe.

Treatment: Bed rest

Right artificial pneumothorax failed 26/9/44

Right phrenic crush 20/9/44.

Pneumoperitoneum 6/10/44 - abandoned 10/2/45.

On discharge 29/3/45 against medical advice general condition unchanged. Sputum T.B.Plus.

X-ray: Cavitation in right lower lobe persisting.

Present condition: Recently readmitted, and disease having remained localised to right lower lobe case considered suitable for Lobectomy.

Comment: Phrenic and pneumoperitoneum in this case had little or no effect after three months, and so abandoned. In view of good general condition and localised disease, and contra-lateral lung appearing healthy, he has been recommended for right lower lobe lobectomy.

CASE NO.29. Female Age 19 Land army worker.

Admitted 26th March, 1943.

History: Cough with sputum (T.B.Plus) began December, 1941. Pulmonary tuberculosis diagnosed, and patient admitted to Ventnor Sanatorium January, 1942. At this time x-ray showed: area of soft mottling confined to right lower zone. Right artificial pneumothorax induced 7/2/42, but was abandoned on discharge in October, 1942 because of fluid.
Cough with sputum (T.B.Plus) returned within three months and re-admission advised.

On admission: General condition good. Afebrile. Blood sedimentation rate 31/64mm. Cough troublesome. Trace of sputum T.B.Plus.

X-ray: March, 1943 - General pleural thickening on right partially obscured the lower zone, but appearances suggested collapse of lower lobe. Left lung appeared clear.

Treatment: Bronchoscopy - mass of granulation tissue found partially filling right main bronchus - silver nitrate 30% applied.

Patient took own discharge 28/5/43.

She continued under dispensary observation until her readmission was recommended in May, 1945.

State on readmission: General condition good (There had been a gain in weight). Temperature occasionally to 99°. Sputum a trace - T.B.Plus.

X-ray May, 1945. Right: Pleural thickening not now so marked. Fresh mottling upper zone, where cavitation suspected. Collapse of lower lobe persisted.

Left lung remained clear.

Bronchoscopy: tight stricture now present right lower lobe bronchus.

Treatment: Bed rest

Right pneumonectomy 8/10/45.

Comment: In the presence of a stenosed right lower lobe bronchus and active disease in ipse lateral upper lobe it seemed justified to recommend pneumonectomy in this case. PATIENT WELL AT TIME OF REPORTING.

CASE NO. 30. Male Age 17 Messenger boy.

Admitted 20th May, 1938.

History: Complaint of vague pain in chest off and on over a period of nine months. Cough had been present for two months prior to diagnosis in 1938.

On/

On admission: General condition fair. Temperature occasionally to 99°F. Blood sedimentation rate 10/28mm. Sputum T.B. Plus (Half an ounce).

X-ray: 2/6/38 - See Figure IX showed bilateral cavitation at hilar level.

Treatment: Left artificial pneumothorax 13/6/38

Right artificial pneumothorax 26/9/38

Left adhesion section 4/8/38.

On discharge 29/7/39 general condition good. Afebrile. Blood sedimentation rate 2/6mm. Bilateral A.P. appeared to control the disease.

Follow-up: Artificial pneumothorax maintained as an out-patient and condition remained satisfactory until September, 1941 when obliterative changes developed, particularly in right pleural space, and cavitation once again became obvious in right lower zone.

On Re-admission: 6/11/41 - general condition poor; temperature 98/100°F. Blood sedimentation rate 44/79mm. Sputum T.B.Plus.

Treatment: Monaldi tube drainage 30/1/42 undertaken without effect on size of cavity.

On discharge 7/5/42 condition worse, and died October, 1942.

Comment: It is more than likely that persisting adhesions on the right side were the responsible factor for re-activation of disease in this case.

CASE NO.31. Female Age 22 Factory Worker.

Admitted 23rd August, 1943.

History: Admitted to Ventnor Sanatorium May, 1939. Had complained of cough for two months prior to diagnosis. Sputum T.B.Plus.

X-ray at this time - 5/5/39 - showed: Right lung clear.

Left lung: Soft mottling in mid and lower zones with definite cavitation at hilar level.

Treatment: Bed rest

Left artificial pneumothorax induced 29/9/39 - abandoned July, 1940 because of effusion.

No adhesion section.

Left phrenic crush 30/10/40.

Left phrenic evulsion 19/2/41.

Within two months of this spread of disease occurred to right upper zone and right artificial pneumothorax induced 19/8/41.

On discharge from Ventnor one year later Right Artificial Pneumothorax maintained - probably effective - but disease in left lung ? quiescent.

Subsequent history: Three months after return home cough with sputum returned, and re-admission recommended. Resting in bed at home while awaiting admission.

On re-admission: general condition poor. Temperature 98/99.6°F. Blood sedimentation rate 77/105mm. Sputum T.B.Plus (half ounce).

X-ray: 24/8/43 - showed - Right side: Shallow artificial pneumothorax - lung adherent apico-mediastinally.

Left side: Mottling upper and mid zones with definite cavitation in upper zone. General pleural thickening. Dome of diaphragm high in position.

Treatment: Bed rest.

Pneumoperitoneum induced 21/9/43 - Followed by definite general improvement, and radiologically disease in left lung hardened. It appeared probable at this stage that patient might be fit enough for radical treatment on left side at a later date. Thus, right adhesion section undertaken 27/1/44 and collapse much improved. Pneumo-peritoneum maintained until 27/11/44. By this time general condition good, and although disease in left lung still active it appeared in the main productive in type. Two-stage thoracoplasty was carried out without upset, and at time/

time of reporting appears to be effective.

Comment: A satisfactory result for combined intensive therapy.

CASE NO.32. Female Age 42 Factory Worker.

Admitted 23rd January, 1942.

History: Cough of four months duration. Some loss of weight. Haemoptysis prior to admission.

On admission: General condition fair only (obvious loss of weight) Temperature to 99°F. Blood sedimentation rate 35/71mm. Sputum T.B.Plus.

X-ray: See Figure VIII

Right side: Mottling mid and lower zone with cavitation mid zone.

Left side: Scanty mottling mid zone.

Treatment: Bed rest

Right phrenic crush 21/2/42

Pneumoperitoneum 13/3/42.

Right artificial pneumothorax refused.

On discharge 25/7/42 general condition good. Afebrile. Blood sedimentation rate 13/32. Laryngeal Swab negative on culture. Radiologically mid zone cavity appeared closed.

Follow-up: Pneumoperitoneum refills continued as an out-patient until May, 1944. One year later patient is well and working and disease remains quiescent.

Comment: Apparent cavity closure and healing following phrenic and pneumoperitoneum.