INTRATHORACIC CYSTS and TUMOURS

A clinico-pathological study of cases coming to operation in a Thoracic Surgical Unit within a 10 year period.

by

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"Those who have dissected or inspected many bodies have at least learned to doubt; when others who are ignorant of anatomy, and do not take the trouble to attend to it, are in no doubt at all". Morgagni.

"All sciences are connected; they lend each other material aid as parts of one great whole... As an eye torn out or a foot cut off, so it is with the different departments of knowledge; none can attain its proper result separately, since all are part of one and the same complete wisdom". Bacon.

"It is of use, from time to time, to take stock, so to speak, of our knowledge of a particular disease, to say exactly where we stand in regard to it, to enquire to what conclusion the accumulated facts seem to point and to ascertain in what direction we may look for fruitful information in the future". Osler.

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Foreword.

No attempt has been made to discuss all the possible intrathoracic cysts and tumours; only common conditions and those occurring during the ten year period in one thoracic unit have been included. In the discussion on pneumonectomy for carcinoma and survival rate brief reference is made to cases subsequent to the 10 year period reviewed, in fact, to early 1953.

Some variation in the nomenclature of the bronchial anatomy as described in the X-ray and other reports with that used in the thesis will be noted. I have endeavoured throughout to use the nomenclature agreed upon at the International Conference held on this subject (Brock, 1950), but I have left unaltered the factual reports of other people as I look on these as quotations. The main difference will be found in the upper lobe the three divisions of which are now called apical, posterior and anterior; the apical on occasions has been reported as pectoral and the posterior as subapical or axillary.

I have arranged the thesis to start with extra-pulmonary lesions such as neurofibroma and extrapulmonary cysts, followed by lesions in the lung proper starting with the simple conditions of lung cyst, hydatid cyst and passing on to the solid tumours - adenoma, pulmonary

adenomatosis and carcinoma.

Because of the large number of cases reported in detail it has been necessary to group them in several volumes - the thesis proper is written in volume one; the simple cases are No. 1 to No. 47; the malignant cases are No. 48 to No. 103 and the cases of differential diagnosis are No. 104 to No. 136.

At one time I had hoped to lighten the burden of the reader by reporting the cases in the text but this now seems quite impossible and would cause too much interruption. The cases are arranged as far as possible in the order in which they are first referred to in the text. In the simple conditions a brief case summary is given at the commencement of the relevant section but no account of this is taken in the subsequent arrangement of the cases.

Introduction.

Thoracic surgery was still very much in its infancy in 1942 when I started to collect the records and pathological material for this thesis, scarcely nine years had passed since Evarts A. Graham had performed in America the first successful pneumonectomy for cancer. In this country comparatively few such pneumonectomies had been carried out and these chiefly only in the preceding five or six years. At that time the diagnosis of lesions in the chest was haphazard and based on no very secure foundation. The extensive ignorance of the significance of many clinical signs and X-ray appearances was being underlined by finding at operation frequent errors in diagnosis. It seemed worthwhile to try to correlate the clinical picture, the X-ray appearances, the bronchoscopic picture (particularly in cases of carcinoma) with the pathological specimen and the appearances within the chest seen at operation. I felt that if this correlation was carried out much useful knowledge and information would follow and one would learn the true significance of many clinical signs and X-ray appearances. The experience gained from these studies has proved to be of the utmost value and it is now possible, having viewed a shadow within the chest

on appropriately taken X-ray films, to be able from past knowledge and experience, to state the site and probable pathological nature of the primary lesion and, if intrapulmonary, the segment of lung involved. Thus a dense rounded shadow lying posteriorly in the superior mediastinum is generally due to a neurogenic tumour; a rounded or pear shaped shadow in the mediastinum, centrally placed in the lateral film, is most likely to be a bronchogenic cyst; while a spherical or lobulated swelling more or less centrally placed antero-posteriorly in the anterior mediastinum will be a lesion within the thymus, such as a thymoma or a dermoid cyst. Following the researches of Brock (1948 & 1952), intrapulmonary wedge shaped shadows can now be recognised with considerable confidence as being due to atelectasis of a segment of the lung and the exact segment definitely named.

The undoubted increase in the incidence of carcinoma of the bronchus emphasised the necessity of familiarising oneself with as much information on the subject as possible. Only in this way could one hope to diagnose the condition at an earlier stage and thus improve the patient's chances of successful operation and survival. For example, from this it has become

clear that any persistent alteration in a middle aged patient's cough, any delay in resolution or recurrence of pneumonia or persistent haemoptysis should be viewed with grave suspicion as being due to a bronchial carcinoma.

In an endeavour to reach an earlier diagnosis in these cases I examined the sputum for tumour cells in many patients with suspected carcinoma. Undoubtedly this is a method of investigation of considerable value in expert hands but I was forced to forego this aspect of the work because I found that my knowledge of cytology was too inexpert and the pressure of routine surgical work was too demanding to permit of the somewhat lengthy microscopic study required in each case, but I found the experience was valuable.

The surgery of carcinoma of the bronchus in 1942 and in the subsequent six years presented several problems of grave concern in the patient's prognosis, problems which seemed worthy of study. Foremost amongst these was the frequent failure to maintain closure of the bronchus after pneumonectomy, indeed up to and including cases in 1948 over 40% certainly developed a broncho-pleural fistula and a further 20% probably developed such fistula. Various steps were taken to combat this complication until now a

method of closing the bronchus has been evolved whereby fistula does not occur. The seriousness of broncho-pleural fistula is found in the fact that practically all these patients died either directly from the fistula and consequent tension pneumothorax or from the subsequent empyema.

In carcinoma of the bronchus I hoped by preserving the specimen in such a way as to retain its shape (as far as possible) and by subsequent carefully placed "cuts" to obtain a picture comparable to that seen on the X-ray film. Thus one hoped to be able to produce a pattern tumour and its lung effects to fit accurately appropriate X-ray appearances.

Features such as segmental collapse of a lobe could be confirmed by demonstrating within the specimen a tumour occluding that segmental bronchus. In the same way I hoped to be able to explain the reason for various bronchial deviations and distortions seen on X-ray films by finding a tumour or lymph node pressing on that bronchus and causing distortion. It seemed that if one could demonstrate the latter feature in some cases it might influence one in the approach to that type of case and perhaps even decide one against the advisability of operation. For example, in a case with a tumour in the

lung substance and a rounded shadow at the hilum pressing on or altering the stem bronchus, could one on occasions say categorically that is an invaded gland and that being so from past experience this case is inoperable? Alternatively, if one diagnosed an invaded hilar gland before or during the operation could one by comparing the specimen and the follow up decide whether resection was justifiable or not? Would the patient survive any length of time? It seemed that a histologicaly study of the tumours removed would confirm or disprove the apparent greater malignancy of oat-cell tumours, a view so often reported, and if this greater malignancy was confirmed could one prove definitely that such a tumour was or was not worth removing?

Throughout the ten years that this study has taken, many other problems have been considered and weighed in the balance of test and experience. In some of these a definite answer has been found, in some no more than an impression has been formed, while in others the answer is still unknown. Such problems concerned the question of post-operative drainage tubes and if they were used how long should they be left in situ? If no drainage was carried out should the chest be aspirated in subsequent days and, if so, should the fluid all be

removed or just sufficient to keep the bronchus suture area "dry" and above the "watermark" and thus encourage obliteration of the space (as one thought), the popular belief being that the fluid would subsequently become organised. Our practice in these matters is now securely founded on observation and experience derived largely from the cases that follow. Another problem concerned the value of post-operative X-ray therapy and while no definite routine has been carried out (in other words, it has not been the custom to irradiate all pneumonectomy cases with invaded glands) it has been possible to state an "impression" about this problem (see page 281).

From 1942 to 1952 I have collected and analysed all the simple tumours and cysts. These are made up as follows:- adenoma, bronchogenic cysts, dermoid cysts, neurogenic tumours, thymic tumours. I have, however, confined my analysis of malignant tumours to the 55 bronchial carcinoma which were ultimately resected, but I shall refer to certain inoperable cases to illustrate several points. I personally washed, pinned out, injected etc. 93 of these specimens; I dissected these and arranged the material for photography. In most cases where the lung or lobe was removed intact a

satisfactory correlation was achieved between the X-ray appearances and the morbid anatomy of the specimen; as experience grew this proved to be of the greatest value in interpreting new cases and enabled me to project previous experience particularly in the reading of X-ray films. The areas for histological examination were personally selected and the prepared slides have all been examined by me. From these slides whether the diagnosis was made by me alone or confirmed by a professional pathologist the fields for photomicrography were either chosen using a Maltwood Finder or directly selected at the time of photography.

Defects seen or errors of judgement made in the method of cutting specimens or in the areas selected for photomicrography are certainly mine and are not the fault of the photographer.

While I personally operated on several of the cases included in this series the majority were operated on by Mr. Bruce M. Dick with myself as first assistant.

Neurogenic Tumours.

In this group of tumours there were 12 cases, 11 of which were operated on and the diagnosis confirmed. The unoperated case showed the x-ray appearance typical of neurofibroma in that it occupies the posterior aspect of the apex of the left hemithorax. Mr. Dick advised against operation as the patient was comparatively free of symptoms. Of the 11 cases subjected to operation 7 were found to be ganglionic neuroma and 4 were neurofibromata, one of the latter occurred in a case of generalised neurofibromatosis.

Ganglioneuromata.

Case No.2, (page 387) A boy aged 5, developed congestion of the lungs five months prior to admission. X-ray examination at this time revealed what was thought to be a cyst in his left chest, but later in the thoracic unit this was thought to be a solid spherical mass. It occupied the left chest posteriorly extending from the apex to the level of the ninth rib. The tumour had widened the first three dorsal inter-vertebral foramina and there was a prolongation of the tumour into the third foramen. When examined after operative removal the tumour was found to weigh 412 gms. (15¼ozs.) and to have the structure of a ganglioneuroma.

The patient made a good recovery and remained well.

Case No. 3, (page 393) A male aged 17, had been known to have a "dullness" at the right lung base for 5 years. Having had his attention drawn to this area he began to experience a dull ache and he became aware of a lump at this site. The lump was more prominent when he bent forward. Nevertheless, he was able to play rugby (scrum half) for his school team and was considered to be a good player. On examination for admission to the banking profession the abnormality in the thorax was recognised and he was referred to Hairmyres. He was found to have a spinal "gibbus" from the 10th to 12th dorsal vertebrae and a moderate scoliosis convex to the right with consequent flaring outwards in a posterior direction of the right lower ribs. X-ray examination showed a mass in the right lower chest, pushing back between the heads of the 11th and 12th ribs; the 11th rib was subluxated upwards and the 12th appeared to be fractured. Dorsal vertebrae 10, 11 and 12 showed erosion which reached the laminae of the 11th and 12th vertebrae; this decalcification had caused partial collapse of the vertebrae. At operation a large lobulated mass occupied almost the entire right

hemithorax. It was adherent to mediastinum, spine and diaphragm. Excision of the tumour was extremely difficult and was carried out by removing it piecemeal. The amount of tumour tissue removed weighed 1871 gms. (4lbs. 2 oz.) and the growth was a ganglioneuroma. Perhaps this tumour should be regarded as locally malignant on account of the notable degree of fusion with adjacent structures and bone changes. It is the only one with such properties in the group of cases.

Case No. 6, (page 413) A 13 year old schoolboy was admitted to Falkirk Infirmary on account of unrelated symptoms and during his stay in hospital x-ray examination of his chest revealed a mass in the postero-superior aspect of the left chest. At operation a neoplasm was found in the paravertebral gutter in contact with the bodies of the 2nd, 3rd and 4th thoracic vertebrae. Two prolongations of the tumour extended into the second and third intervertebral foramina and a third had attachment to the origin of the descending aorta. The tumour was kidney shaped and measured 10 x 5 cm. in size. It had the usual naked-eye appearances of a ganglionic neuroma and microscopic examination confirmed this diagnosis. The patient made a good recovery.

Case No.10, (page 439) A labourer aged 55, had had a slight, but persistent, cough for six months. An opacity in the apex of the right lung seen by fleuroscopy was diagnosed as a carcinoma of the lung. At operation a hard mass was found in the paravertebral gutter in the superior mediastinum. Biopsy tissue only was removed and proved to be from a ganglioneuroma. Reference to the x-rays of this case show a rather wedge-shaped shadow: an unusual appearance for an intra-thoracic nerve tumour which usually shows as a dense rounded shadow. Recovery was satisfactory and despite failure to remove any substantial mass of the tumour, its progress is likely to be very slow and the prognosis is fairly good.

Case No.5, (page 408) A soldier aged 25, was discovered on mass radiography to have a shadow in the posterior aspect of the left superior mediastinum, the situation and characters of which suggested a neurofibroma or ganglioneuroma. It had a prolongation into the 4th intervertebral foramen and had eroded the pedicle of the 4th dorsal vertebra. After removal the growth measured 5 cms. in diameter and contained scanty ganglion cells. Death occurred suddenly some hours later.

Case No. 7, (page 420) This 48 year old female was found on mass radiography to have a large shadow in the posterior part of the upper half of the left chest, i.e. in the site for a nerve tumour. At operation a prolongation of tumour tissue was found to extend into the 4th intervertebral foramen. A tumour weighing 1247 gms. (2lbs.12ozs.) was successfully removed and proved to be a ganglionic neuroma. Recovery was uneventful.

Case No. 12, (page 450) This female child of 3 years had recurring chest colds for six months with persistent fever thought to be pneumonia. Clinical and radiological examination revealed a well defined neoplasm of the posterior superior mediastinum on the right side. This was removed surgically and proved to be a rather immature type of ganglionic neuroma. The child made a good recovery and remained well.

Neurofibromata.

Case No. 9, (page 427) This 49 year old patient for 5 years had had progressive pain in the right axilla, down the arm and into the fingers of her hand. The pain became so severe that she had had to give up her work and there was evidence of involvement of the

brachial plexus resulting in atrophy of the intrinsic muscles of the hand. For eighteen months she had a cough productive of purulent sputum and accompanied by increasing breathlessness. There were signs of generalised cutaneous neurofibromatosis and a mass of similar character occupied the posterior mediastinum. When removed at operation the tumour measured 9 x 7.5 cms.; it had attachment to the brachial plexus. This patient subsequently died during a post-operative chest aspiration, possibly from air embolism.

Case No. 1, (page 381) This 36 year old engineer four and a half years prior to admission to the thoracic unit and again one month before admission developed pain at the 5th dorsal vertebra. This pain radiated round the right side of the chest, upwards over the sternum and downwards over the epigastrium. In spite of the unusually low site on the vertebral column a pre-operative diagnosis of intrathoracic neurofibroma was made and this was confirmed. At operation a tumour 3.3 x 2.5 cms. in size was removed from the lateral aspect of the 5th dorsal vertebra medial to the descending aorta. The growth was a simple neurofibroma and the patient made a good recovery.

Case No. 11, (page 443) This 40 year old

housewife had been breathless for two years prior to operation and suffered from arthritis. X-ray examination revealed a tumour in the upper right chest. An artificial pneumothorax was induced and the lung collapsed away from the tumour and the chest wall. The site of the tumour and its appearance were suggestive of neurofibroma. This diagnosis was subsequently confirmed. The growth removed at operation was 10 x 7.5 cm. in size. It appeared to be attached to the second intercostal nerve at the neck of the second rib. Recovery from the operation was satisfactory and there was no recurrence of the tumour.

Case No. 4, (page 403) A 39 year old clerkess was x-rayed prior to going to Canada and was found to have a shadow in her right chest. Previously she had had no symptoms. A neurofibroma, the size of an apple, was removed. It had a narrow pedicle of attachment to the region of the middle of the first rib. Recovery was satisfactory.

Case No. 8, (page 424) An electrical engineer aged 24, had complained for 7 years of vague pains in the anterior aspect of his chest. On x-ray a rounded homogeneous mass was seen occupying the posterior

aspect of the apex of the left hemithorax.
Operation was not thought to be necessary and he was dismissed with advice to be examined regularly.

A Survey of the Features of Intrathoracic Neurogenic Tumours.

The literature on this subject is confusing, particularly in regard to the exact pathology of these tumours and to the chances of malignant change occurring in them. Two main varieties are encountered, those arising in the course of peripheral nerves and those connected with the sympathetic nervous system. With regard to the first group any nerve may be the site of origin of a neurofibroma but they usually arise from intercostal nerves. There is still some confusion as to their exact origin, while in general it is agreed that they arise from the nerve sheath from which part of the sheath is still controversial. The confusion has been increased by the wide variety of names applied. Those arising from intercostal nerves have been variously described as fibroblastomas, schwannomas, neurilemmomas, fibromyxomas, fibroneuromas, etc., generally speaking these tumours are usually spoken of as neurofibromas. From the welter of pathological detail written on this subject one finds the clinician taking recourse to the use of the term "neurofibroma" for those tumours commonly found arising somewhere in the course of the peripheral nerves and if malignant

features develop, neurofibroma undergoing sarcomatous change.

The second group, i.e. tumours arising from the sympathetic nervous system, have been classified by James and Curtis (1941) under three main headings with various subdivisions -

1. completely undifferentiated sympatheticoblastoma,
2. incompletely differentiated tumours,
3. differentiated forms, especially ganglioneuroma.

With intrathoracic tumours arising from the sympathetic nervous system the type most often seen is the ganglioneuroma. Kent et al (1944) point out the importance of careful search through all areas of the tumour in order to obtain a true diagnosis. In some specimens many sections may show the appearance of a typical neurofibroma with spindle-shaped cells set in a well-formed fibrillar matrix. Whorl formation is a frequent feature. Hyaline degeneration with cyst formation or calcification may occur (Case No. 1, page 381). When further search is made it may reveal areas of multipolar ganglion cells.

In the thorax these tumours lie with few exceptions in or near the posterior mediastinum and in the apex of the thorax. In the 11 cases operated on in this series

10 were lying in the posterior mediastinum; in some of these the tumour had reached such massive dimensions that only a small part remained in contact with the mediastinum (Case Nos. 2 and 3, page 387 & 393), the remaining case was found in the lateral chest wall (Case No. 4, page 403). Kent et al (1944) had 21 cases, 19 of which were in the posterior part of the thorax and only 2 were in the anterior mediastinum. They collected a further 101 cases from the literature; only 2 of which were in the anterior mediastinum. D'Abreu (1947) reported 8 cases of which 7 were operated on; 4 were in the typical site in the posterior mediastinum, one a large ganglioneuroma was in the anterior mediastinum and the remaining two were in the lateral aspect of the chest wall.

It is well recognised that some of the nerve tumours arise within the intervertebral foramina and that in their growth they may extend both into the spinal canal and also outwards into the thorax. In 4 of my 11 cases a prolongation of tumour tissue could be seen at operation to pass into an intervertebral foramen causing dilatation of the foramen, (Case Nos. 2, 5, 6 and 7, page 387, 408, 413, 420). In Case No. 6, (page 413) the tumour passed into intervertebral foramina 2 and 3 and in Case No. 2, (page 387) it widened intervertebral foramina 1, 2 and 3 and had an obvious extension into 3.

In none of these cases was there any evidence of pressure symptoms from the intervertebral projection of the tumour. When the projection into the intervertebral foramina enlarges it will of necessity project into the spinal canal and there produce symptoms and signs of intraspinal tumour related to the level at which the tumour lies. When the tumour reaches such dimensions as this it will of necessity consist of two portions, a larger intrathoracic mass and a smaller intraspinal mass, the two being connected by a narrow strip of tumour, hence the name hour-glass or dumb bell-shaped tumour. It seems likely that where there is widening of the intervertebral foramen without obvious intraspinal extension the tumour had enlarged the foramen by the pressure of its growth in the thorax rather than that the tumour had its origin in the nerve as it passed through the foramen. This would appear to be rather confirmed by the fact that all four of these tumours were ganglioneuromata which presumably are much more likely to arise from the region of the sympathetic ganglionic chain than from the much smaller rami communicantes. That these tumours may grow to a large size within the thorax is evidenced particularly in Case Nos.2 and 3 (page 387, 393); in the former

the portions of tumour removed weighed 1871 gms. (4lb. 2oz.), while in the latter, a child of 5, it weighed 412 gms. (15¼oz.) and extended from the 1st to the 7th dorsal vertebra. That this size may be reached by rapid growth is borne out by the case reported by McFarland (1931) which weighed 2041 gms. (4½lb.) after apparently growing for only one year. While pathological fracture of ribs should always be viewed with suspicion as it may indicate malignancy, it should not preclude the possibility of surgical intervention in cases whose other features are suggestive of simple nerve tumour in view of the fact that decalcification and even fractures of rib may be the result merely of pressure. Case No. 5, (page 408) had erosion of the pedicle of the 4th dorsal vertebra; while Case No. 3, (page 393) showed subluxation of the 11th rib and erosion of the 10th, 11th and 12th dorsal vertebrae extending in a lateral direction as far as their respective laminae; these vertebrae were partially collapsed. The unoperated case (Case No. 8, page 424) showed pressure erosion of the neck of the 2nd rib.

Mediastinal nerve tumours, arising as they do from intercostal or sympathetic ganglionic chains,

originate in the region of the lateral aspect of the vertebral bodies. As they increase in size they push the intact pleura in front of them thus making a false capsule for themselves. As growth proceeds adjacent structures are displaced; in Case Nos. 9 and 10, (page 427, 439) the trachea was pushed to one side; in Case No. 1, (page 381) the aorta was encroached upon; all showed some displacement of lung, the largest tumours having caused almost total collapse.

There has been much argument as to whether these tumours undergo malignant degeneration or start in displaced embryonic tissue having potential malignant properties. Similarly, there is divergence of findings in reported series of cases. Of the 12 cases here discussed only one (Case No. 2, page 387) though diagnosed histologically as a simple ganglioneuroma, could be looked on at least as locally invasive on account of the huge size to which it had grown and the decalcification and collapse of three vertebra which it had caused.

While many neurogenic tumours become malignant it is worthy of note that Cushing & Wolbach (1927) report the case of a boy in whom at 2 years of age a sympatheticoblastoma was partly removed and in whom

re-operation 8 years later revealed that the tumour had developed into a ganglioneuroma.

Kent & Blades (1944) found 41% malignancy in the series of intrathoracic neurogenic tumours at the Barnes Hospital, St. Louis. In a review of 105 reported cases they found a malignancy rate of 37%. These figures appear to correspond with the incidence of 41% malignancy found by Geschickter (1935) in his review of 850 primary nerve tumours from other parts of the body. Blades (1946) in a further series of Army cases, had only 1 malignancy in 30 cases. D'Abreu (1947) reported 8 cases of neurofibromata, in only one of which malignant change was present, but subsequently 2 further cases were seen, both of which were malignant.

Rarely, primary solitary neurogenic tumours occur within the lung; none has been seen in this series. Diveley & Daniel (1950) reported the successful removal of a simple tumour in the middle lobe of the right lung of a 35 year old male; a second intra-pulmonary case in the left upper lobe was treated by pneumonectomy and found to be a neurogenic sarcoma with secondary nodules in the mediastinum. In a review of the literature they were only able to find

one other example of each type.

While Case No. 9, (page 427) is an example of generalised neurofibromatosis with a solitary mediastinal neurofibroma, in my series there was no instance of multiple neurofibromatosis scattered throughout both lungs without evidence of neurofibroma-:tosis elsewhere in the body as was found by Rubin & Aronson (1940) in a 57 year old diabetic negro woman. Scattered over the surface of both lungs there were numerous projections of tissue with narrow pedicles and throughout the cut surface of the lungs they found small masses 0.5 to 3 cm. in diameter. When this patient had been in hospital 4 years previously these tumours had been seen on x-ray examination as multiple shadows throughout both lung fields and naturally had been diagnosed as multiple malignant secondaries from an unknown primary. X-ray of the chest 4 years later showed no alteration in these appearances. One of the nodules had broken down and become infected. Death resulted from a marked basal meningitis presumably originating from the resultant lung abscess.

Clinical Picture.

In the 12 cases discussed in this group the ages ranged from 3 to 55. Kent et al (1944) reported

in their series of 21 cases a girl aged 5, while at the other extreme, Rodriguez & Brito (1951) operated on an 80 year old man and removed a small neurofibroma. There were 7 males and 5 females. Sex incidence varies widely in the reported series of cases, in general men are more commonly affected than women. Rodriguez & Brito (1951) found the sex incidence to be equal, Kent et al (1944) on the other hand had 14 men as against 7 women.

Many cases are discovered quite incidentally. Case Nos.4, 5 and 7, (page 403, 408, 420) were picked up in the course of mass radiography survey; others are discovered by chance x-ray of the chest for some other condition (Case No. 6 page 413). It is not surprising that a higher percentage of accidentally found cases should occur in America where routine x-ray of chest is taken of every patient entering hospital. In consequence a proportion of the cases have no symptoms. In this way Kent et al (1944) reported 8 out of 21 cases as incidental symptomless findings.

When symptoms occur they are usually mild in character and associated with pressure effects. There may be only a sensation of vague discomfort in the

chest or, as in Case No. 1, (page 381) where the tumour has intimate relationship with an intercostal nerve, the main or only feature may be pain referred along the intercostal nerve. Occasionally, the referred symptoms are more accurately localised as in Case No. 9, (page 427) in which the main symptoms were spasmodic pain in the arm, forearm and hand accompanied by numbness and tingling. The pain was so marked in the hands and fingers as to affect her grip. Loss of sensation was found in these areas and there was wasting of the thenar eminence. In this case at operation the tumour had attachment to the lowest trunk of the brachial plexus. When the tumour reaches moderate to large size pressure effects become more frequent and may include unproductive cough due to pressure on and possibly displacement of the trachea (Case Nos. 9 and 10 page 427, 439) accompanied in some cases by stridor. Where the tumour is bulky a considerable portion of the lung may be collapsed with consequent breathlessness (Case Nos. 10 and 11 page 439, 443). Pressure effects may also involve the recurrent laryngeal nerve with consequent hoarseness and when the sympathetic chain is affected a Horner's syndrome may develop.

Seven of the twelve cases had definite abnormal physical findings on chest examination. All 7 showed impairment to percussion, an actual area of dullness over the tumour site being noted in 6. In Case No. 12, (page 450) these findings were sufficiently obvious to cause an initial diagnosis of pneumonia. In all the other cases the respiratory murmur was reduced in quality as was the vocal fremitus and resonance. In Case No. 9, (page 427) the respiratory murmur over the tumour area was bronchial. Naturally these cases which showed abnormal physical findings had the largest tumours.

The outstanding clinical feature of nerve tumours is found on x-ray. In no other condition is the diagnosis so positive. In the postero-anterior film the tumour is seen as a solid dense shadow with a well circumscribed smooth margin. The following cases are classical examples; Case Nos. 2, 4, 5, 7, 9, 11 and 12, (page 387, 403, 408, 420, 427, 443, 450). In the majority of cases it occupies the summit of one or other side of the thorax, (Case Nos. 2, 5, 6, 7, 8, 9, 10, 11 and 12 page 387, 408, 413, 420, 427, 439, 443, 450). The diagnosis is clinched when on the lateral film the shadow is seen to be in the posterior

mediastinum and on screening is found to be non-pulsatile (Case Nos. 1, 2, 5, 7, 8, 9, 11 and 12, page 381, 387, 408, 420, 424, 427, 443, 450). If there is a prolongation of the tumour into one or more intervertebral foramina, evidence of such can usually be seen on appropriately taken x-rays as widening of that foramen (Case No. 7, page 420). Pressure effects may be seen in erosion of ribs or vertebrae and may lead to fracture in the former and collapse of the latter (Case No. 3, page 395).

The lobulated appearance seen in the x-rays of Case No. 3, (page 395) should make one suspicious of rapid growth and therefore suggestive of malignancy. Kent et al (1944) believe that the presence of a pleural effusion does not justify the assumption of malignancy and they quote a case of Harrington's in which a benign neurofibroma was removed in spite of the presence of a blood stained pleural effusion.

A correct pre-operative diagnosis is nearly always reported in those posterior mediastinal tumours. One requires to consider in the differential diagnosis such conditions as bronchogenic cysts, dermoids and retrosternal goitres. Cysts and dermoids are not usually quite so highly placed in the mediastinum and

on lateral x-ray lie centrally in the former and anteriorly in the latter (Case Nos. 20 and 16, page 516, 485). Intrathoracic goitre is generally said to occur in the anterior mediastinum but that has not been universal in my experience. Case No.109, (page 1223) has been chosen to exemplify several cases in which the intrathoracic portion of the goitre gave rise to difficulty in diagnosis by having passed down the left lateral aspect of the trachea eventually to reach a position posterior to it, the trachea being displaced forwards and to the right. The diagnosis of the unusually placed lateral and anterior nerve tumours is much more difficult and they are apt to be diagnosed as bronchial cysts or dermoids, (Case No. 4, page 403).

Treatment.

It is essential that these tumours be removed at an early stage. Even if they do not become malignant - and a relatively high malignancy rate has been reported in many reviews - they may enlarge to such an extent that they interfere with, or threaten to destroy by pressure closely related structures, by which time their removal will be both difficult and dangerous. Admittedly, some cases have been observed for years without any

change in size. Kent et al (1944) report a case in which the growth remained constant in size for six years but in a further five years it had increased markedly. McFarland (1931) reported a tumour in a 12 year old girl reaching 2041 gms. (4½lb.) in weight in one year.

X-ray therapy has no place in the treatment of these tumours nor is it of diagnostic value in "test" dosage for it has very little effect on either the simple tumours or the malignant ones.

Fortunately operative removal of the average sized tumour is a simple matter. The usual highly placed and posterior situation makes them easily accessible through a posterior thoracic approach which aims at opening the chest through the bed of the resected 3rd or 4th rib. The tumour is found well encapsulated and the pleura covers it as a false capsule and strips readily from its surface. The tumour can then be eased out of its bed near the necks of one or more ribs and frequently the only obstacle to complete enucleation is a small pedicle to its nerve of origin. This, however, is easily clamped, divided and ligated (Case Nos.1, 4 and 11, page 381, 403, 443). If there is a small intervertebral foramen

extension it can usually be dissected out (Case Nos. 2, 5, 6 and 7, page 387, 408, 415, 420).

When, however, the tumour is dumb-bell shaped and has an intraspinal projection, the operation should ideally be carried out in close co-operation with a neurosurgeon. In these circumstances, it is generally advised that the first step should be the removal by the neurosurgeon of the intraspinal portion and if the patient is still in good condition the intrathoracic portion is then dealt with; if the patient's condition does not warrant further intervention the intrathoracic portion is left to a later date.

When the tumour is of very large size operation is fraught with difficulty because of adhesion to the chest wall and important structures. Under these circumstances it may be possible to perform only a biopsy or, as in Case No. 3, (page 395), to remove the most prominent lobules of the growth. The risk of haemorrhage is serious and in my opinion diathermy should be available at such operations to assist in the control of haemorrhage.

Operative Mortality.

As would be expected the operative mortality varies with the type and the extent of the tumour found. The straightforward simple nerve tumour should present no difficulty at operation and in consequence has a negligible mortality. It is a different matter when the tumour is large and densely adherent, here the operation is both difficult and dangerous, post-operative death from shock or haemorrhage being not infrequent. Three deaths occurred in the 9 cases operated on. Case No. 9, (page 427) died in circumstances which might obtain as an unhappy sequel following any thoracic operation. On the eighth post-operative day while her chest was being aspirated she suddenly fell back dead. Necropsy was not obtained and death was presumably due to the aspirating needle puncturing the lung and giving rise to air embolism. Case No. 5, (page 408) was found to have an intraforaminal extension of his tumour. This was effectively removed but haemorrhage was brisk. Before the chest was closed the haemorrhage was thought to be controlled by packing. On his return to bed and while he was gradually recovering consciousness he suddenly collapsed and

died, presumably from a brisk haemorrhage which, in his already weakened condition, he was unable to withstand in spite of transfusion. One feels that perhaps had diathermy been available a more determined effort might have been made to control the haemorrhage at operation; even if the bleeding point was not visible a bent applicator could have been passed into the foramen to touch and coagulate the bleeding area. Case No. 3, (page 393), the third death, had a massive ganglioneuroma which had been densely adherent to diaphragm, chest wall and spine, complete removal being quite impossible; as it was, the removal of several large lobules of tumour weighing 1871 gms. (4lb.2oz.) was achieved with great difficulty and with considerable shock to the patient. Early the following morning he died from surgical shock and haemorrhage in spite of transfusion with blood and plasma. Kent et al (1944) reported 3 deaths in 19 operations. One of these deaths was very similar to Case No. 5, (page 408) in that a brisk haemorrhage occurred during the final stages of enucleation of the tumour; the haemorrhage could not be controlled. D'Abreu (1947) was more fortunate, having no deaths in 7 successful operations.

The prognosis in the case surviving successful

operative removal is excellent. In view of the nature of the tumour one would expect that recurrence would be common but in the simple non-adherent nerve tumour this is not so. The probable reason for this fortunate outlook is that the tumour under these favourable circumstances will be well circumscribed, non-adherent and ensheathed in pleura, and will have as its sole attachment to nerve tissue a tenuous narrow pedicle. All of these features ensure certainty of complete removal and recurrence is never reported in this type of case. The prognosis in the adherent and rapidly growing nerve tumour is less favourable, despite a subsequent simple histological report. In this type of case complete removal may well be impracticable and subsequent extension of growth inevitable. The frankly malignant tumour will in all probability at operation only provide material for diagnostic purposes, removal in toto being usually out of the question. This is particularly true of the malignant sympathoblastoma which may show its inoperability by secondaries in the axilla (Pauline, 1947). D'Abreu (1947) had a malignant case with secondaries in the neck. To ensure a good prognosis the correct treatment is operative removal as soon as

the condition is diagnosed and thus avoid the technical difficulties and dangers attendant on the removal of a large tumour of long standing. Early operation should reduce not only the number of malignant growths found but also the number of growths found to be irremovable at operation.

Summary of Intrathoracic Neurogenic Tumours.

From the review of these 12 cases it may be concluded that simple intrathoracic neurogenic tumours show a noteworthy similarity in their radiological features, their sites of origin and their histological structure. These features are so pronounced that the diagnosis can now be made confidently pre-operatively, but that was by no means so when this work was begun. The characteristic features these growths show on x-ray examination are their position high in the posterior mediastinum, their uniformly dense, clean cut and usually spherical shadow. When they attain to any size they displace the lung forwards and related mediastinal structures may be displaced forwards and to the opposite side. Pressure effects on the trachea or bronchi may cause an irritating cough or if more extensive produce atelectasis and infection in part of the lung which may lead to a misdiagnosis of pneumonia. Pressure on the lowest trunk of the brachial plexus may cause pain in the arm, forearm and hand with atrophy of the intrinsic muscles of the hand; if the pressure is against an intercostal nerve "root" pains will result. Pressure on bone may cause decalcification and erosion; where the ribs are involved this may lead to fracture

or subluxation of their posterior ends; in the case of the vertebral bodies this may cause collapse with resultant scoliosis and kyphosis. At operation the site and solid nature of the tumour are confirmed as it lies extra-pleurally in the paravertebral gutter. It is well encapsulated and usually has a narrow pedicle of attachment to an intercostal nerve; "finger-like" prolongations of the tumour may be found extending into dilated and eroded intervertebral foramina.

Extrapulmonary Intrathoracic Cysts & Dermoids.

I have separated the extrapulmonary intrathoracic group of cysts which have no apparent developmental relationship to lung from those cysts which have such a relationship and I have included extrapulmonary bronchogenic cysts in the group of pulmonary cysts. There are five extrapulmonary intrathoracic cysts in this series, three of these are dermoid or teratomatous and two are epithelial.

Case No.16, (page 485). This 40 year old railway worker was admitted to another hospital on account of symptoms of prolapsed intervertebral disc. While he was in hospital it was noticed that his fingers were clubbed. An x-ray of his chest revealed a shadow in the anterior mediastinum at the level of the 3rd, 4th and 5th left costal cartilages. The tumour was removed at operation. It was lying below the left pulmonary artery to which it had a narrow pedicle of attachment. The tumour was 4 x 3 cm. in size; it was mainly solid and contained several bars of cartilage; the cystic spaces were lined by modified squamous epithelium. The lingula was completely separate from the upper lobe. He made a good recovery.

Case No. 15, (page 477). A 29 year old housewife, while in hospital recovering from rheumatic fever, complained of pain in her chest. X-ray revealed a cyst in the left chest. She was three months pregnant at the time. After the delivery of a full time baby she was re-admitted and the cyst was removed. It was in the anterior chest and extended from the left subclavian to the diaphragm; it was adherent to the pericardium, the lung and the left pulmonary veins. A portion of pericardium required to be removed with the cyst wall. The cyst contained blonde hair and a tooth. A small portion of cyst wall required to be left densely adherent to the subclavian vessels. The cyst contained areas of squamous epithelium and ciliated columnar epithelium. The more solid areas contained cartilage, sweat glands and fat. She made a good recovery.

Case No. 17 (page 493). A 36 year old woman two months prior to admission developed a chest cold following which she experienced pain in the left chest and down the left arm. Three weeks before entering hospital a lump appeared in the anterior aspect of the left chest just above and merging into the breast. With the appearance of the swelling the pain disappeared.

This swelling extended from the second to the fourth costal cartilage. X-ray showed a shadow in the left anterior mediastinum. The swelling was explored and found to be cystic and to contain cheesy material; it extended deep to the sternum. Six weeks later the chest was opened and the cyst was found anterior to the ascending aorta in close relationship to the pulmonary artery and the left auricle. During removal the cyst ruptured and purulent material mixed with inspissated pultaceous material escaped. Much of the cyst wall was calcareous. Unfortunately when the tissue was examined no epithelial lining was found; in consequence it could only be reported as an infected cyst. Clinically, however, the cyst resembled a dermoid. She made a good recovery.

Epithelial Cysts.

Case No. 13, (page 456). A man aged 52 had been breathless on exertion since early adult life. Ten years prior to admission his chest was x-rayed because he had had a bad chest cold: a mass was found in the right upper chest. On admission he was noticed to have stridor and a husky voice. The right chest was prominent in the upper third anteriorly where movement and percussion were impaired. In this area the

respiratory murmur was diminished. X-ray revealed a dense rounded opacity in the upper posterior chest. There was no erosion of ribs or vertebrae. At operation a partly cystic tumour was found and removed. The fluid from the cyst was yellowish grey and contained cholesterol. The cyst wall contained fibrous tissue with many cholesterol "clefts". No cyst lining was found. He died from shock three hours after the operation.

Case No. 14, (page 467) A 14 year old boy had had a feeling of tightness in his right chest off and on for four years. He was always breathless on exertion and he had always had a cough. At the age of 6 months he had been in the Royal Hospital for Sick Children with a cyst at the base of the right lung; the cyst was aspirated and several subsequent x-rays showed the chest to be clear. On admission to the thoracic surgical unit examination revealed diminished movement and impaired percussion at the right base. There was marked scoliosis convex to the left. X-ray revealed a large cyst in the right chest lying posteriorly in the mid-zone. The cyst was removed. It had attachment to the region of the necks of the 7th and 8th ribs. The cyst measured 10 x 7 cm; its wall varied from 2 mm. to 2 cm. in thickness and it contained many hard plaques of cartilage. The wall

consisted of dense fibrous tissue containing many cholesterol clefts. The lining was degenerate. He made a satisfactory recovery.

Classification & Etiology.

The mediastinum is the site of a large variety of cysts and cystic tumours which Laipply (1945) classifies as follows:-

	Type	Derivation
1. Congenital	Epidermoid cyst	Ectoderm
	Dermoid cyst	Ectoderm & Mesoderm
	Teratoma	Ectoderm, entoderm & mesoderm
	Pericardial coelomic cyst	Mesoderm
	Bronchial cyst	Entoderm & mesoderm
	Oesophageal cyst	Entoderm & mesoderm
	Gastroenteric cyst, gastric cyst, enteric cyst	Entoderm & mesoderm
	Cystic lymphangioma	Mesoderm
2. Acquired	Parasitic cyst	T. Echinococcus
	Neoplastic cyst	Degeneration in solid tumour
	Cystic haematoma	Degeneration of a haematoma

He found that epidermoid, dermoid and teratomatous cysts and tumours were by far the most common, 244 having been reported in the literature, to these he added one of his own. In 1951 Fralick and Welsman reported one dermoid and one malignant teratoma;

at the same time they reviewed 251 cases in the literature. It is not clear whether they include epidermoid cysts in this total.

J.A. Gordon reported the first dermoid cyst of the mediastinum in 1823. It occurred in a woman of 21 and contained sebaceous matter, hair, bone and teeth. Fralick and Welsman (1951) quote the first correct diagnosis during life as being made in 1869 when the patient concerned coughed up hair. They do not name the author of this case.

Clearly these cysts are developmental in origin but their exact nature is controversial. Although the monogerminal and bigerminal views afford some explanation for the development of these tumours, as Laipply (1945) points out, they offer no explanation as to why 65% of these tumours remain dormant for years and do not manifest themselves until the patient is over 20 years of age. Of the three dermoid cysts in my series none occurred under the age of 20, their ages were in fact 29, 36 and 40. Two other cysts were of more indeterminate pathology and were probably epidermoid; the ages of these patients were 14 and 52.

Pathology.

Neither epidermoid cyst had an epithelial lining; usually they are lined by stratified squamous epithelium with or without sebaceous glands and an outer layer of dense fibrous tissue. The contained fluid may be clear, watery and yellowish grey as in Case No. 13, (page 456), thick yellow as in Case No. 14, (page 467) or more solid pultaceous material which may contain hair.

The dermoid cysts as one would expect from their layers of origin - ectodermal and mesodermal - have features common to the epidermoid cysts with in addition bone, cartilage, teeth and muscle.

It is doubtful whether one is justified making a distinction between the epithelial and dermoid cysts.

The teratoma is usually more solid than either the epidermoid or dermoid tumours; it contains elements of both with, in addition, tissue from one or more of the following - the digestive or respiratory tracts, thyroid or thymus. The cyst in Case No. 15, (page 477) contained hair, one tooth, cartilage, sebaceous glands and islands of columnar epithelium probably of respiratory type. In the words of

Nicholson (1934) "teratomata are the most complex and monstrous of tumours. They introduce us into a world of phenomena undreamed of in normal evolution. They lead to an understanding and just appreciation of the countless unending potentialities of living matter".

Fralick and Welsman (1951) believe that many cases contain elements necessary for such a teratomatous diagnosis but these are not found because, either extensive necrosis of the tissue has occurred and a true histological picture is not obtained, or a single germ layer, particularly ectoderm, has overgrown the other layers or that insufficient material has been taken for histological examination.

Although they are more solid than epidermoids or dermoids they frequently contain one or more cysts which may be lined by stratified squamous, cuboidal or columnar epithelium. They may reach a large size and vie with lipoma as the largest mediastinal tumour. Doran and Lester (1939) report one which weighed 5.3 kilograms and quote a report by Frose and Hospers of one weighing 9 kilograms. Both the cystic and the more solid types are potentially malignant; approximately 30% of the malignant transformations

occur in the cystic cases and 70% in the more solid tumours. Of the 245 epidermoid, dermoid and teratoma cysts reviewed by Laipply, 11.4% were malignant.

Dermoids and teratomas are almost invariably found in the anterior mediastinum in front of the heart and great vessels. Gebauer (1943) recorded an intrapericardial teratoma.

Sex and Age Incidence.

Of the five cases included in this series three were males and two were females. Laipply (1945) found that in the 224 cases (including both simple and malignant tumours) in which the sex was stated the proportion of males to females was 106 to 118. The great majority of primary malignant teratomata occur in males in a proportion of 8 to 1 (Fralick and Welsman, 1951).

As already mentioned the youngest patient was 14 and the oldest was 52. Laipply (1945) found the youngest was a stillborn child and the oldest a woman of 62. Although he found 20% occurred under the age of 17, the majority were reported to be between 17 and 40 years of age. Although these cysts result from faulty development in embryonic life they do not manifest themselves until adolescence or early adult life.

The tumour's increase in size proceeds in step with the body's natural growth; this with the additional enlargement consequent on the retention of squames plus continued secretion within the cyst presumably results in the cyst reaching sizable proportions in adolescence or early adult life. No doubt inflammation in surrounding structures in some cases may result in an increase in the quantity of fluid secreted into the cyst; similarly infection in the cyst itself or malignant change may occur to cause enlargement. On the other hand, many of these tumours never attain any great size nor produce symptoms and are found quite unexpectedly on routine or post-mortem examination.

Symptoms & Signs.

The symptoms and physical signs are essentially those of a space-occupying lesion within the chest. The tumour as it lies in the anterior mediastinum presses on related structures thus the most common symptom is paroxysmal cough presumably due to pressure on the trachea or larger bronchi.

Cough. Of the 5 cases, three had cough as the presenting symptom and in two of these (Case Nos. 13 and 14, page 456, 467) the cough had been present

for 13 years. The fourth case (Case No. 15, page 477) while in hospital with rheumatic fever five years previously had complained of pain in her chest and x-ray at that time revealed the presence of a cyst. The fifth case (Case No. 16, page 485) four months before admission to hospital developed pain in his back and other symptoms suggestive of a prolapsed disc. While he was being examined for this condition it was noticed that he had clubbing of his fingers. An x-ray of his chest was taken and a shadow was seen in the left chest near the left hilum. This was diagnosed as a pulsating aneurysm but he was sent to Hairmyres for opinion and the true nature of the condition was then discovered.

Case No.13, (page 456) was known to have had his cyst for 15 years, while Case No. 14 (page 467) at the age of six months was in the Royal Hospital for Sick Children with a cyst in the right lower chest which was aspirated on several occasions and it was ultimately reported that his chest X-ray was normal. Thirteen years later he reported to Hairmyres with a cyst in the same area. Laipply (1945) found that while one fifth of the case histories were of less than six months duration, any period up to twenty years was a

relatively common occurrence; one case had a history of forty years duration.

Dyspnoea on exertion is a common symptom and was present in the two epidermoid cysts and in one dermoid. The larger the cyst the more lung ventilation space is occupied and the greater the degree of breathlessness. In some instances the breathlessness may take the form of periodic asthmatic attacks.

Pain. Complaint is often made of pain in the chest. It occurred in one epidermoid and in two of the dermoid cases. It may be a feeling of tightness in the chest or it may be more definitely pleuritic or even anginal in type. Haemoptysis may be present and the expectoration of hair, though very infrequent, is diagnostic; sebaceous material and fat droplets may be present in the sputum.

Dullness, on physical examination is the most frequent finding (Laipply, 1945); it was a feature in all five cases reported here. Bulging of the related area of the chest is the next most frequent occurrence and was present in two cases (Case Nos. 13 and 17 page 456, 493). A natural accompaniment of both these features was diminished or absent breath sounds over the area of the tumour.

Sites. If the tumour is large or if it occupies the superior portion of the mediastinum there may be displacement of the trachea with prominence and distension of cervical and upper thoracic veins from pressure on the superior vena cava; in some cases, there is oedema of face, neck and arms accompanied by cyanosis, most marked on exertion. If the tumour lies close to the heart and is of some size the latter will be displaced.

Further colouring of the clinical picture occurs if the pressure on a bronchus is sufficient to produce a partial or complete blockage. There will then be added the features of pulmonary atelectasis, pneumonia, bronchiectasis or lung abscess with pleural reaction in the form of clear effusion or empyema. The onset of infection in the tumour will be dramatic and almost certainly of grave outcome. In the previously unsuspected case there will be a sudden onset of symptoms. Symptoms already present will be more marked and accompanied by hectic fever, and, if the tumour ruptures into a bronchus, by abundant offensive sputum.

A positive Aschheim-Zondek test has been recorded in teratomatous tumours containing chorion-epithelioma structure. X-ray investigation as in all intrathoracic

cysts and tumours is bringing an ever increasing number of these tumours to light before the onset of symptoms. They are usually circular or oval, possibly of large size and a characteristic feature is their situation in the anterior mediastinum - virtually the only tumour of that shape and uniform density found in this site. If the tumour is entirely cystic it will have a clear cut edge and be of uniform density throughout; part or all of the wall may show a rim of calcification (Case Nos. 15 and 17, page 477, 493). In some instances denser areas of opacity are seen within the tumour and indicate the presence of teeth or bone. If the tumour has ruptured into a bronchus a fluid level will be present. Lobulation or rapid increase in size is suggestive of malignant change.

Differential Diagnosis.

In the thoracic surgery unit at Hairmyres Hospital it has been found that tumours in the anterior mediastinum are either dermoids or teratomata; tumours of the thymus are usually less well defined and respond readily to X-ray therapy.

Case No.104, (page 1185) is an example of a thymic tumour in a man of 46 in whom the clinical picture was

that of myasthenia gravis responsive to injections of prostigmin. The tumour was considerably smaller than the dermoids and when removed at operation was found to be a cyst 5 cm. in diameter lying free within which was a dark red mass 3 cm. in size. This mass proved to be of dense fibrous tissue.

Case No. 105 (page 1194) is a further example of thymic tumour. The x-ray picture shows an ill-defined mass in the anterior mediastinum. Operation biopsy in this case indicated that the tumour was a reticulum-cell sarcoma of thymus. The tumour was treated with x-ray therapy and decreased in size. Thereafter the patient lived in comparative good health for over four years, at the end of which time she had a nephrectomy for a similar condition of the kidney. Shortly after the operation she died. At autopsy examination Professor Lendrum found the disease had spread to the other kidney, the suprarenal and the pancreas; there were also tumour deposits in the cervical glands.

Case Nos.106 & 107 (page 1206, 1212) showed enlargement of the thymus due to lymphadenoma which responded to X-ray therapy. Case No. 106 (page 1206) is still alive ten years later, although recurrences in the cervical area still require treatment.

In these affections of the thymus the X-ray appearances show an opacity with an ill-defined edge, an opacity which melts very rapidly with X-ray therapy. In Case No.106 (page1206) the opacity disappeared in three months after treatment and did not reappear. In dermoids and teratomata X-ray therapy causes no alteration in size.

Case Nos.108 & 109 (page1217, 1223) are typical examples of retrosternal extension of goitres arising from normally placed thyroids. These are in the superior mediastinum, and in their descent into the thorax they pass from the anterior position downwards and backwards, two to the left of the trachea and one to the right, a position which a dermoid or teratoma rarely occupies. The tumour is seen on the x-ray screen to move on swallowing.

Case No. 16 (page 485) prior to his admission to the thoracic unit was diagnosed as an aneurysm of the ascending aorta. Many cases of aneurysm have a calcified rim; by no means all are pulsatile. If aneurysm is suspected a positive Wassermann reaction may help to confirm the diagnosis although many cases of aneurysm are of non-specific origin.

Treatment.

As all these tumours are potentially malignant it is desirable that they should be excised soon after they are diagnosed. If they are left and even if they do not undergo malignant change, they are still liable to cause grave effects by increasing in size and if inflammatory changes occur chronic invalidism or death from infection or haemorrhage may result.

The first operation on a dermoid was in 1871 when Polin drained one which presented in the neck; the first successful removal was performed by Bastionelli (Laipply, 1945).

When malignant change has occurred it is too late to operate for there is no recorded instance of permanent cure under these conditions (Fralick & Welsman, 1951).

All 5 cases in my series were operated on through the postero-lateral approach. All the dermoid cases (Case Nos. 15, 16 and 17 page 477, 485, 493) survived operation but one epidermoid, Case No. 13 (page 456) the oldest patient and the largest tumour, died. He was not very robust and probably died from surgical shock. In only two cases (Case Nos. 15 and 17 page 477, 493) was it impossible to remove the entire

growth. In Case No. 15 (page 477) the tumour was densely adherent to the left subclavian vessels to which a small portion was left attached; this was a dermoid and contained a tooth, a mamilla and blonde hair. In Case No. 17 (page 493) part of the cyst lay between the aorta and pulmonary artery and required to be left where it was adherent to the latter.

The operative treatment of choice would seem to be complete or as nearly complete removal as possible at the first operation. Laipply (1945) found 55 cures in 76 cases so treated. It is a tempting surgical step to drain or marsupialise large cysts but this tends to lead to infection and makes subsequent operation much more hazardous. Smith & Mills (1938) feel that drainage adds danger to later operation and rarely benefits the patient. Only one cyst (Case No. 17 page 493) was drained and that was done in the belief that one was dealing with a chronic abscess of some kind (as indeed was the case) before the correct diagnosis was appreciated.

Laipply (1945) found the operative mortality to be 18.3%. With antibiotics, better anaesthesia and more certain surgery this figure should be much lower

in any review dealing with cases in recent years, to say nothing of early chance X-ray diagnosis in the pre-symptom phase.

Cystic Disease of the Lungs.

There is no more interesting simple lesion involving the lungs nor one in which there has been so much controversy regarding its etiology than congenital cystic disease. Although the condition was recognised in the 17th century when three cases were reported on by Thomas Bartholinus in 1687 (quoted by Oughterson & Tuffel, 1936) it is not until the last 30 years that it has come into such prominence mainly the result of the advances in X-ray diagnosis and the confirmation afforded by surgery. In the now voluminous literature on the subject reference will be made to the papers by Koontz (1925), Wood (1934, 1937 & 1944), Schenck (1936 & 1937), Sellors (1938) and Willis & Alreyda (1943).

In 1925 Koontz made an extensive study of the literature and found rather fewer than 100 examples of what he believed to be true congenital cysts of the lung. Wood (1934) reported 16 cases at the Mayo Clinic. By 1936 Schenck reported 232 cases in the literature and added 4. In 1938 Sellors while adding 32 cases of his own found that the total had reached 400, and five years later Willis & Alreyda (1943) added another 85 cases to the already rapidly increasing number.

Solitary Pulmonary Cysts.

In my own series of cases there are six confirmed and two probable but unconfirmed solitary pulmonary cysts and one infected cyst.

Case No. 19 (page 509) a 5 year old girl had had a pneumonic-like illness some months before admission to the thoracic unit. X-ray revealed a thin-walled cyst containing fluid in the left lower chest (but after four months the cyst contained air). At operation a cyst measuring 11 x 6.5 cm. practically replaced the lower lobe. The cyst was removed along with the lobe. When opened the cyst was found to be crossed by several cord-like strands which microscopically were seen to be covered with stratified columnar epithelium. She made a good recovery.

Case No. 18 (page 502) a 40 year old housewife with a three months history of tiredness stated that at the onset of her illness she had a violent bout of coughing during which she coughed up half a pint of dark red fluid. X-ray showed a cyst with a fluid level in the apex of the right lower lobe. Right lower lobectomy was performed. The cyst was lined by respiratory pseudo-stratified ciliated epithelium. She made a good recovery.

Case No. 21 (page 524) a 29 year old housewife had had several attacks of breathlessness for two years and for five months she had had pain in the left chest. At operation a tumour 10 cm. in diameter was found lying extrapleurally in front of and to the left side of the heart. It had a narrow pedicle of attachment to the aortic arch. The tumour was removed. It consisted of one large and several small cysts lined by columnar epithelium which in places appeared to be ciliated. It was diagnosed as a bronchogenic cyst. She made a good recovery and was symptom free when dismissed from hospital.

Case No. 20 (page 516) a 24 year old merchant seaman was found on mass radiography to have a mass in the left upper chest. At operation a white lobulated tumour 7 x 6.5 cm. in size was found and removed from the mediastinal aspect of the left upper lobe. The pedicle of the tumour was attached mainly to the pulmonary artery, to the upper lobe and to a lesser extent to the aortic arch. On section the tumour was found to be almost entirely cystic, the contained fluid being greenish-yellow and of a musty odour. The cyst was lined by ciliated columnar epithelium and the solid areas contained cartilage and mucous

glands. It was diagnosed as a bronchogenic cyst. He made a good recovery.

Case No. 22 (page 532) a 4 year old boy who had always had frequent chest colds and breathlessness was operated on for what was thought to be a neurofibroma; instead a cyst was found in and removed from the posterior mediastinum. The cyst contained 550 c.c. of brownish-black fluid; it was attached to the oesophagus just below the azygos vein. The cyst lining was deficient but in places ciliated columnar epithelium was found. It was diagnosed as a bronchogenic cyst. He was dismissed well.

Case No. 23 (page 539) a 40 year old typist gave a five year history of vague indigestion and discomfort in the right lower chest; for one year she suffered from nausea and at times food was regurgitated. She had no difficulty with swallowing. Barium swallow showed a smooth filling defect in the oesophagus just below the level of the bifurcation of the trachea. The condition was diagnosed as a simple tumour of the oesophagus, at operation, however, a cyst 5 x 4 cm. was found attached to the right main bronchus and completely free from the oesophagus. It was removed; during removal it burst and yellow creamy

fluid escaped. The cyst was lined by ciliated columnar epithelium and was diagnosed as a bronchogenic cyst. She made a satisfactory recovery, but was admitted six months later to the medical wards for six weeks and diagnosed as a case of neurosis.

Case No. 24 (page 546) For three years a poorly nourished girl of 4½ had had attacks of respiratory embarrassment including stertorous respiration. On several occasions considerable amounts of fluid had been aspirated from her chest, the fluid was sometimes clear and sometimes haemorrhagic. X-ray showed a large spherical swelling occupying the greater part of the left chest; it also extended into the right hemithorax and had pushed the heart and trachea into the right chest. The cyst was aspirated and 1500 c.c. of straw coloured fluid was removed. This allowed the mediastinum to return to its normal position and the left lower lobe to re-expand. Because of her poor condition and because she had chorea and pericarditis she was transferred to the medical wards without operation.

Case No. 25 (page 549) Unfortunately neither clinical history nor an account of any operation of this young boy is available but his X-ray appearances are reasonably typical of a bronchogenic cyst.

Table No. I.

Solitary Pulmonary Cysts.

	Diagnosis confirmed	not confirmed	Excision or lobectomy	Satisfactory result
No. of cases	6	2	6	6

Infected Solitary cyst.

Case No. 26 (page 553) A 43 year old man was X-rayed one year prior to admission. A shadow was seen in the left mid-zone and was diagnosed as a simple tumour. Six weeks before admission his cough became more severe and he expectorated much putrid sputum. X-ray examination on admission revealed a large cavity with a fluid level in the left lower lobe. In all probability this was a case of lung cyst which ruptured, the contents being partly coughed up and the cyst becoming infected. A catheter was inserted into the cyst and 200 c.c. of sterile purulent fluid were evacuated. He died suddenly two months later.

Multiple Cysts of Lung
(Congenital cystic bronchiectasis).

During the time of collection of this series of cases there were too many of this type to justify citation in extenso. Three of them have been selected to represent this group, which numbered over 40.

Case No. 28 (page 563) a schoolboy, aged 10, had had trouble with his chest since he had pneumonia at the age of three months. He was subject to winter colds and bronchitis; he suffered from breathlessness. He was intelligent but very much underweight. X-ray revealed deviation of the mediastinum to the right and many grape-sized cystic spaces in the right lung. At operation the right lung when inflated by the anaesthetist resembled a bunch of grapes. The lung after removal and when sectioned showed a series of cystic spaces and no normal lung tissue. The spaces were lined by ciliated columnar epithelium. He made a satisfactory recovery.

Case No. 29 (page 567) a 20 year old shop assistant had had trouble with her chest since she had measles and whooping cough at the age of 2. Three months before admission to hospital she had a haemoptysis. Her physique and nutrition were poor. X-ray showed cystic disease in the apical and pectoral segments of the left upper lobe. Lobectomy was carried out. Histological examination revealed the alveoli to be lined by cubical epithelial cells. This case may be one of acquired rather than congenital bronchiectasis. Her subsequent progress was excellent.

Case No. 27 (page 557) a 19 year old shop assistant had "congestion" of her lungs at the age of 2, subsequently she was breathless on exertion and had frequent chest colds. X-ray showed displacement of the mediastinum to the right and widespread cystic disease of the right lung. At operation the lung was found to be completely replaced by a cluster of grape-like cysts (Fig. 83 page 562). She made a good recovery.

Bronchiolectasis.

There is one case of bronchiolectasis which occurred in a man of 43 and which is referred to in detail in the text.

Emphysematous Bullae.

Several cases occurred in this group and three of these have been chosen to illustrate this condition.

Case No. 33 (page 601) a 14 year old schoolboy had enjoyed good health until the age of 13 when he noticed that following exertion he was having giddy attacks and blurring of vision. He had no cough or spit and no breathlessness. He had occasional pain in the left chest on exertion. X-ray revealed emphysematous bullae in the left lower lobe. At operation the lower edge of

the lower lobe presented an unusual appearance. From the whole of its lower surface there hung down a series of bullae the size of very large grapes. When some of these bullae were opened they were found not to be true cysts but areas of very rudimentary lung - air spaces traversed by strands of lung and fibrous tissue. The lobe was removed. His recovery was satisfactory.

Case No. 32 (page 593) a post office van driver, aged 46, had been breathless on exertion for four years and breathless at rest for two years. He had a cough with a moderate amount of sputum occasionally streaked with blood. His previous illness included congestion of the lungs, pneumonia and a spontaneous pneumothorax which had occurred respectively 20, 8 and 3 years previously. When admitted his accessory respiratory muscles were required even at rest in bed. There was little respiratory movement of his barrel-shaped chest. X-ray showed giant bullous cysts of the right lower and middle lobes. During the anaesthetic induction with pentothal breathing ceased and required to be maintained by controlled anaesthetic respiration throughout the operation. As soon as the chest was opened a distended air filled cyst presented in the wound. The cyst was opened and dissected out. Two other smaller cysts

were found and removed. He never recovered completely from the operation and died sixteen hours later.

Case No. 31 (page 586) an inspector of transport, aged 51, had sustained a gunshot wound of his chest at the age of 19. Since that injury he had suffered from breathlessness which had progressively increased in severity and during the past ten years had been disabling. He was living on continuous oxygen by the time he was admitted to the thoracic unit. His chest was hyper-resonant and practically immobile on respiratory excursion. X-ray of his chest was reported as showing a complete right pneumothorax and a partial left pneumothorax (Fig. 93 page 590). Phrenic nerve crush operations were carried out at a two day interval with slight improvement. A catheter was subsequently inserted into the huge bullous cyst in the right chest but the patient died a week later. At post mortem the right chest was found to be filled by one very large bulla while the left side of the chest contained four bullae, the largest of which was 18 cm. in diameter (Fig. 94 page 591).

Classification of Pulmonary Cysts.

In view of the uncertainty of origin of pulmonary cysts it is not surprising that their classification is

equally confused. Many classifications have been proposed (Schenck, 1937; Wood, 1937; Willis & Alreyda, 1943). I have based my system of classification on that of Sellors (1939) who divided his cases into the following groups.

1. Solitary cysts. These are almost invariably of large size -
   (a) Huge balloon or distension cysts - usually found in infants.
   (b) Smaller cysts - about the size of an orange.
2. Multiple cysts. These are of variable size -
   (a) Medium sized in groups of 2 or 3.
   (b) Small cysts which may be
      (i) following a set distribution, e.g. lobar
      (ii) diffuse or scattered cysts of inconstant size.

In the etiology of lung cysts two main types are recognised, viz. congenital and acquired.

Congenital Cysts. Many theories have been propounded as to the origin of congenital cysts of the lungs. Proof of the congenital origin is furnished by Smith (1925) who found in a newborn baby bilateral cysts varying in size from a pinhead to a pea. Rigler (1943) reported cysts in one lung in a child X-rayed because of dyspnoea on the day it was born.

Schenck (1936) believed that congenital cysts result from a simple arrest in development at a period of advanced lung development. He accounted for the variation of tissue in the wall of different cysts by the stage of intra-uterine lung development at which the agenesis occurred. He believed that the defect of development had occurred at the time of bronchial divisions and growth in those cysts which contained unstriped muscle, elastic and fibrous tissue and on occasions cartilage. That the lining might be ciliated columnar, cuboidal or flattened epithelium could be explained by such factors as ballooning of the cyst the result of increasing tension within it. In the same way different histological features would be seen if the cyst were the result of a fault in development of the atria, infundibula or alveoli.

Others (quoted by Schenck, 1936) stated that the cysts were in the nature of tumours; that they resulted from inflammation in the foetal lung with consequent bronchial stenosis and distal dilatation; that they were the result of dilatation of the lymphatics; that they were the result of congenital syphilis.

Sellors (1939) was impressed by the similarity between cyst formation in human lungs and amphibian or

reptilian lungs. He felt cyst formation might be in the nature of an atavistic deformity or the reversion to a more primitive lung, that the swim-bladder of the fish was perhaps the ancestor phylogenetic prototype of the single lung cyst while the more specialised respiratory apparatus of amphibia represented the more complicated forms such as the multiple cysts. In support of his views Sellors pointed out that cystic changes were found in a high proportion of accessory or abnormal lobes some of which had shown evidence of a throw-back in evolution. He also found that many had other congenital defects; in his total of 32 patients there were 9 congenital deformities of the heart and several instances of cystic kidneys and polycystic livers.

Koontz (1925) had previously drawn attention to the number of such patients who had congenital heart defects. He had noted the presence of atelectasis in many cases of cystic disease of the lungs and he felt that congenital heart lesions, in particular patent foramen ovale and patent ductus, led to an imperfect pulmonary circulation which in turn contributed directly to the non-expansion of areas of the lungs.

Acquired Cysts. The origin of acquired lung cysts also is enshrouded in uncertainty; some doubt their existence others accept them but disagree as to their mode of origin. Wood (1937) believes that the cysts are not acquired if they do not contain pigment and conversely that a cyst is not congenital if it does. Oughterson & Tuffel (1936) rightly point out that this is not strictly true and that the amount of pigment deposit depends on the amount of air circulating through the cyst, the tendency to deposition on the cyst wall and its capacity for removal, e.g. by ciliary action.

Willis & Alreyda (1943) believe cysts can develop as a result of acute or chronic inflammation in the broncho-alveolar tree and they quote, among others, Fuscher-Wassels, Rohmary & Maccone in support of this view. They believe that a progressive state of fibrosis in chronic interstitial pneumonitis induces sufficient contraction to make alveolar emphysema assume cystic proportions, and that in lobular pneumonia the development of cystic bronchiectasis may be caused by bronchial inflammation plus these alveolar changes, diminishing resistance of the remaining alveoli to distension.

Cystic Bronchiectasis. Maier (1941) believes that

cystic bronchiectasis should be classified as a form of bronchiectasis rather than as a form of lung cyst; further it is now generally recognised that the wall of a lung abscess may become epithelialised and so give rise to another type of cyst, the origin of which in an abscess may not be appreciated unless a series of X-ray films of the case are available for study.

No discussion on the development of cystic disease of the lungs would be complete without consideration of giant emphysematous bullae. Allison (1947) states that these large bullae result either from stenosis of a small bronchus or bronchiole with over distension of the lobule of the lung supplied by that small bronchus or bronchiole or else by ulceration of a bronchus with the greater escape of air on inspiration into the interstitial tissues of the lung than is able to regain the bronchus or bronchiole on expiration. Maier (1941) believes the smaller bullae - the so-called emphysematous bullae - result from fragmentation of the elastic tissue which allows rupture of the interalveolar septa to take place. This occurs as a rule throughout the lung but tends to be more localised round the lung edge and if confined to one area a bulla results. Because of its mode of development it has a poor though often multiple communication with the bronchial tree.

Pathology and Clinical Features of Solitary Cysts.

In this condition it seems desirable to consider the pathology and clinical features at the same time because of their close relationship and inter-dependence.

Sex and Age Incidence.

The sex incidence has varied somewhat from one series of cases to another. In this series there were 5 females and 4 males. Wood (1937) in a series of 232 cases, found males three times more commonly affected than females. Schenck (1936) found 107 males as against 88 females, while Sellors (1939) in his series of 32, found the sexes practically equal.

In regard to the age at which onset of symptoms occurs this will vary with the type of cyst and its size. Many patients with small solitary cysts have no symptoms referable to them, whereas a large balloon cyst may show its presence at birth. The youngest case in my series was aged 4 and the oldest was 43. Schenck (1936) found 27 cysts manifest themselves at birth, 79 under 5 years of age, and 118 over 15 years of age.

Solitary cysts. As a rule if the solitary cyst is of the large balloon variety it will manifest itself in

the newborn or the young child. After birth it undergoes rapid and colossal distension - which not only causes collapse of the lung but displaces the heart and trachea to the opposite side and in consequence gives rise to progressive respiratory and circulatory distress. Sellors (1939) has noted the tension within the cyst to be so marked as to cause bulging of the affected side of the chest. He explains the cause of the distension by the fact that the cyst is in communication with a bronchus; with the first few breaths of life the lungs expand and the opening of the bronchus into the cyst becomes kinked or compressed with the result that air enters the cyst but cannot escape because the opening closes during expiration. This event occurring in its acute form in the first few days or weeks of life will give the clinical picture of a tension pneumothorax with hyper-resonance, absent breath sounds accompanied by marked mediastinal "shift" and acute respiratory distress which if not relieved may kill the child. Many instances of this type of case are recorded in the literature and some of these were mistakenly diagnosed as cases of tension pneumothorax. 5 of 48 cases reported by Wood (1937) at the Mayo Clinic were diagnosed as such. A useful distinguishing feature between them is the

depression of the affected cusp of the diaphragm consequent on the downward pressure of the cyst; further as Kirklin (1956) points out the cyst wall in contact with the lung shows a regular curved line whereas in pneumothorax the transradiant region is bordered by the dense shadow of compressed lung.

The course of these large cysts may be less dramatic and give rise to more intermittent symptoms presumably because the communication with the bronchus allows only a certain amount of tension to develop, and when this is reached the bronchial opening again closes. The child suffers from recurring attacks of cyanosis and dyspnoea, which features suggest recurring attacks of spontaneous pneumothorax.

The solitary cyst which does not undergo marked distension may cause no trouble for a long time, until, in fact, some accident to the cyst occurs such as infection, rupture into a bronchus or pleura, or until it is found by chance on routine fluroscopy.

X-ray examination will usually reveal the cyst to have a thin wall and will show it to be lying near the periphery of the lung. Such a cyst is usually circular though it may be oval or loculated. The fluid in the cyst may be thin and watery or gelatinous. Such a

cyst may empty itself by rupturing into a bronchus or into the pleura (Case No. 18 page 502). A fluid level will then be seen in the cyst and this will give rise to uncertainty in the diagnosis between lung cyst and lung abscess. Indeed rupture into the bronchus may and often does lead to infection within the cyst and brings a previously silent cyst to notice. In many such cases the correct diagnosis will be made only when tissue is available for histological examination. Cyst infection may also occur from pneumonia or other adjacent infection in the lung (Schenck, 1936). The accident of the cyst rupturing into the pleura when there is a valve-like communication with the bronchus may cause a tension pneumothorax to develop. In point of fact, this is precisely the manner in which many of these cases primarily present. There are good grounds for the belief (Tyson, 1943) that a number of cases of tension pneumothorax are erroneously diagnosed as merely such when in fact they have an underlying lung cyst which is not discovered.

If the cyst is air-filled its lining will be smooth and shining and on X-ray examination numerous bands of delicate structure may be seen to traverse the cyst in wide sweeping curves. Histologically these

bands are usually composed of delicate fibrous tissue. In Case No. 19 (page 509) some of the bands traversed the entire cyst while others only ran a short distance from one wall to the other and gave the impression of chordae tendineae. It is curious that while no epithelial lining of the cyst could be found the strands of tissue traversing the cyst were covered by columnar epithelium several layers thick, in addition many small epithelial lined cysts were present within the larger strands (Fig. 59 page 514).

Lung cysts vary considerably in histological structure. If one accepts the view of development expounded by Schenck (1936) and others that the nature of the cyst depends on the stage of intra-uterine life at which the developmental error or foetal inclusion occurs then the elements found, viz. bronchi, bronchioles, atria or alveoli will give the clue to the appropriate type of cyst. Thus Sellors (1939) has noted in cysts developed from bronchi several layers of epithelial cells with cilia on the surface and goblet cells in the depths. The communication with bronchus may be difficult to find and he stresses the importance of the examination of serial sections. Plaques of cartilage will be found in most of these specimens

(Case No. 20 page 516). In cysts developed from bronchi $\frac{3}{4}$ mm. or less in size, he usually found the epithelium to be reduced to one layer in thickness and cuboidal or flattened and cilia free. Cartilage and mucous glands were usually absent, as were muscle fibres though in the cysts developed from the larger bronchi the latter sometimes presented as tumour-like masses. Carbon pigment is usually absent.

A cyst resembling those developed from the larger bronchi is exemplified in Case No. 18 (page 502), a woman of 40 who after a right sided empyema at the age of 12 had been well until three months prior to admission when she coughed up half a pint of dark red fluid derived from rupture of the cyst into a bronchus with evacuation of its contents. In view of the structure of the cyst as determined by microscopic examination it would seem questionable whether the illness at the age of 12 yrs. was a true empyema following pneumonia; subsequent events suggest that it may have been a congenital cyst which became infected but was temporarily relieved by aspiration drainage. The clinical course subsequent to the rupture of the cyst followed the usual pattern of superadded infection exemplified by the expectoration

daily of several ounces of purulent sputum tinged with blood. On admission to the thoracic unit X-ray examination showed a large cavity with a fluid level in the apical segment of the right lower lobe (Fig.54 page 506) which showed patchy consolidation. The lesion was diagnosed as a lung abscess and was removed by lobectomy; it was 7 x 5 cm. in size and had a smooth shiny lining which at one area showed punctate haemorrhages. Histological examination revealed a lining of pseudo-stratified respiratory epithelium which in places possessed cilia. There were areas of ulceration. Numerous gland-like diverticula were found but no cartilage. The surrounding lung tissue showed fibrosis and chronic inflammatory changes.

Differential Diagnosis of Solitary Cysts.

These cysts usually present as a clinical entity when some complication develops on top of the previously silent cyst and very frequently the differential diagnosis will include exclusion of these complicating lesions. Thus a large balloon cyst may be mistaken for a tension pneumothorax, while a tension pneumothorax may resemble a lung cyst. There may still be some lung tissue seen on X-ray examination in the hemithorax of a tension pneumothorax.

The smaller solitary air filled cysts will require to be differentiated from thin walled tuberculous cavities; in these examination of the sputum may be conclusive, if not, the absence of surrounding tuberculous infiltration will indicate the true state of affairs. The draining and therefore more or less empty pulmonary abscess is usually thick walled and surrounded by pneumonic changes, although differentiation of the more chronic abscess may be achieved only on histological grounds. Diaphragmatic hernia will be excluded by barium investigations. Case No. 110 (page 1228) was a typical example of the latter, numerous cystic spaces were seen in the left lower lobe and were thought to be cysts or tuberculous

cavities until a barium meal showed them to be stomach and loops of small bowel.

Differentiation of emphysematous bullae may be more difficult but correct diagnosis is of little consequence in view of the fact that if they are of any size the treatment will be similar to the treatment of the cyst, namely excision of the bulla or related lobe and bulla.

The fluid-filled cyst requires to be distinguished from lung abscess. In the latter there may be a history of an upper respiratory tract operation such as tonsillectomy or tooth extraction under general anaesthesia. According to Clagett (1944) such is the mode of onset in 56% of cases of lung abscess. If these operations are performed under general anaesthesia without the pharynx being packed off infected particles of tonsil, gum or blood may be aspirated into the trachea and cause blockage of a bronchus with distal collapse and subsequent abscess formation. If the patient is lying on his side during the operation the first bronchial opening for such material to enter will be the axillary and posterior segments of the upper lobe. Brock (1946) drew attention to this fact and pointed out that 54% of abscesses occurred in the upper lobes; 40% in the right and 14% in the left. He found that

of the remaining abscesses (24%) occurred in the right lower lobe and concluded that this was accounted for by the more vertical course this bronchus takes in both the upright and the supine positions. A lung abscess will give a much more acute history with rapid deterioration in health, swinging fever and chest pain. Once the abscess bursts into a bronchus there will be much foetid sputum. X-ray examination will probably show surrounding pulmonary infection though this does not always occur (Case No. 111 page 1233). Once the abscess is partially evacuated a fluid level will be seen within it. As has already been emphasised final diagnosis of this type of case may be made only on histological grounds. As a general rule pulmonary abscess runs a rapid course of atelectasis, followed by breakdown and pus formation culminating in intrabronchial rupture with partial or complete evacuation. Other conditions leading to abscess formation are a breaking down pneumonia (Case No. 112 page 1235) and proximal tumour causing bronchial obstruction.

Obviously it will be exceedingly difficult and at times quite impossible to separate lung cyst and lung abscess when the former has been silent and has recently

become infected, then follows a course similar to that of acute lung abscess with intrabronchial rupture and a residual infected intrapulmonary space. If a series of X-rays are available for study the key to the true diagnosis may be found, otherwise absence of lung infection surrounding the cyst lesion may be the only distinguishing feature.

Encysted effusion or empyema may cause difficulty in diagnosis. As a rule these are posteriorly placed near to or in the paravertebral gutter and are usually low in the chest. An encysted effusion in the upper extremity of the oblique fissure is likely to cause difficulty in diagnosis, usually it is neither clear cut nor circular in outline, being rather more oval or even triangular in shape.

Hydatid cysts may have a raised eosinophil count and a positive complement fixation or Casoni test. Such cysts are usually situated in the right lower lobe.

Dermoid cysts are usually solid and invariably situated in the anterior mediastinum.

Adenoma may appear as a smoothly rounded spherical tumour causing distal lobar or segmental collapse. They give a history of recurring haemoptysis frequently over a period of years but can be excluded by bronchoscopic examination.

Carcinoma is less likely to cause confusion in diagnosis and as a rule will be seen on bronchoscopic examination; it is unlikely to be spherical unless it is a tumour of peripheral type.

The Treatment of Solitary Cysts.

The correct method of treatment of a solitary cyst which is causing symptoms is resection of the cyst. Sellors (1939) maintains that this resection should include adjacent lung tissue. He believes that the reason for the high rate of recurrence in those cysts which are only enucleated results from the fact that there is no capsule to the cysts and presumably some lining is always left behind. The more extensive cysts will require lobectomy or even pneumonectomy (Case Nos. 18 & 19 page 502, 509). Sellors (1939) advocates leaving the asymptomatic cases alone but under careful review and treating them when infective symptoms develop.

If a patient with an already infected cyst reports initially in a toxic condition he may derive benefit from and obtain considerable clinical improvement following bronchoscopic aspiration of the cyst contents.

The huge balloon or tension cysts may present as an acute surgical emergency requiring immediate relief of tension by means of needle or catheter drainage. While this may be required to save the patient's life it is not without danger as leakage of air into the pleura from the puncture opening in the cyst wall may

cause a tension pneumothorax (Schenck 1937). Subsequent excision of such a cyst will be required, preferably when the child is some weeks older. Gross (1946) has successfully removed a lung, the seat of a large tension cyst, in a child only three weeks old. Other methods of treatment are virtually useless, e.g. drainage, application of chemical irritants or attempted collapse by artificial pneumothorax, which may in fact cause enlargement and infection of the cyst (Rigler, 1943; Gale et al, 1937).

Pathology and Clinical Features of Multiple Cysts.

Schenck (1936) found multiple air filled non-expansile cysts of lung to be three times more common in adults than in children whereas all other types were much more common in children.

Multiple cysts may be of moderate or small size; they may involve an entire lung and on occasions in addition to extensive involvement of one lung there may be some involvement of the other. The process may, however, be confined to one lobe and has often been found in the right middle lobe. When the affected lung is sectioned the cysts, depending on their size, will resemble a bath sponge, honeycomb or a bunch of grapes. Case No. 27 (page 557) is an example of the latter; the right lung in this girl of 19 looked like a bunch of grapes, this was particularly noteworthy during the operation of pneumonectomy when the lung had been freed from the chest wall. In this case as in all the others observed in Hairmyres thoracic unit, but not recorded here in detail, the lung is shrunken and much reduced from normal size. The cysts themselves vary in size, shape and in their contents; their walls are smooth and shiny and their contents may be air, serous fluid, pus or

even blood. The spaces, which may be infected, are lined by cubical or columnar epithelium of respiratory type which may or may not be ciliated.

According to Sellors (1938) such cases may have no signs or symptoms until this clinical silence is broken by some comparatively small event such as shortness of breath, unexplained cough or haemoptysis. While agreeing with Sellors (1938) that these cases usually present at school age or early adult life it has not been my experience that they have had an uneventful respiratory life. In my cases the lung condition has usually shown itself, but not been recognised, in early childhood. Case No. 27 (page 557) gives a history which is illustrative of many. At the age of 2 she had "congestion of the lungs" and during her schooling she was off repeatedly for short spells with attacks of chest illness. She had been breathless on exertion for as long as she could remember; she had been aware of a cough and spit for many years but never haemoptysis.

These patients may present in a somewhat under nourished state, with slightly stunted growth and perhaps clubbing of the fingers (Case Nos. 28 & 29 page 563, 567). If the cysts have become infected

there will be all the clinical features of true cystic bronchiectasis with respiratory accompaniments of wide range.

X-ray appearances of the cystic lung are characteristic in that they show the "honeycomb" lung appearance with retraction of the mediastinum to the diseased side. Retraction may be so marked that when the right lung is involved the heart shadow may be entirely in the right chest due presumably to compensatory emphysema of the healthy lung (Case No. 28, page 563).

When the diseased area is localised to a lobe or segment of a lobe and when the cysts are of uniform size, overlap of the edge of one cyst in the centre of the next may give the appearance described by Sellors (1939) as "links of a chain"(Case No. 29 page 567). Instillation of lipiodol outlines these cystic spaces in the form of "puddles". It is undesirable to use the quite large quantity of lipiodol that would be required to fill these cysts and in any event it would be quite unnecessary because the appearance of "puddles" is sufficiently characteristic.

As stated above - owing to frequent symptoms from early life - it is particularly difficult to

distinguish this type of medium or small multiple cyst from acquired bronchiectasis. In the congenital variety the condition may have been completely silent or it may have given rise to symptoms from birth. In bronchiectasis on the other hand the illness will usually have a definite time of onset frequently heralded by an attack of measles or whooping cough with a subsequent history of recurring chest infections with persistent cough and sputum, foetor, breathlessness and clubbing of the fingers. Case No. 29 (page 567) illustrates this type of case; a girl of 20, who at the age of 2 had measles and whooping cough, following which she was seven and a half months in hospital. At this time she suffered from much respiratory illness and had attended a special school. Ever since the initial fevers she had had a cough and wheezy chest. As usual in these cases she had poor nutrition and stunted physique; curiously enough her fingers were not clubbed. Her general condition greatly improved and she put on weight subsequent to left upper lobectomy of a lobe completely replaced by cystic bronchiectasis (Fig. 86 page 572).

A study of the morbid anatomy can be particularly helpful in distinguishing the congenital from the

acquired type. Reference to Fig. No. 83 (page 562) showing the specimen removed from the congenital Case No. 27 (page 557) reveals a lung replaced by cystic spaces, many of the spaces being lined by a wall only a few millimetres thick. These features are in sharp contrast to those found in Fig. No. 86 (page 572) which shows the specimen removed from the case of acquired bronchiectasis (Case No. 29 page 567). In it the striking feature is the enlargement, distortion and thickening of the bronchial elements rather than distortion of the lung parenchyma as occurs in Fig. No. 83 (page 562).

Further contrasting features between congenital and acquired lesions of this type suggested by Sellors (1939) are:-

(a) the smooth lining and empty appearance (unless infected) in contrast to the rough, dirty lining which is often ulcerated and filled with pus.

(b) the predilection for parts of the lung not usually affected by acquired lesions, such as the subpleural areas, middle lobes and the apices instead of a more uniform distribution over one or more lobes, usually the lower lobes.

(c) no obvious relationship to the axis and direction of the air tubes whereas the acquired lesions lie along the line of the normal bronchial anatomy.

(d) cysts being visible in spherical form whereas the dilatations start in a fusiform manner and tend to extend down the bronchus.

Microscopical appearances in the congenital lesion show a regular columnar epithelium unaltered by milder infections in contrast with the acquired lesion in which the columnar epithelium shows inflammatory changes with ulceration, squamous metaplasia and the formation of granulation tissue. In the cyst the straight lumen of the bronchial tube can be seen in one microscopic field; in bronchiectasis the air tubes being tortuous as well as dilated are not seen over any length in any one microscopic field.

Treatment of Multiple, Medium & Small Cysts.

If the multiple cysts are giving rise to symptoms of breathlessness, cough or haemoptysis, or if they become infected, as a general rule removal of the area of lung involved will be called for provided the lesion is sufficiently localised, i.e. involving only one lung. In many cases of honeycomb lung there is no functioning alveolar tissue remaining and if the other lung is healthy extirpation of the affected lung can be looked on to provide a very pleasing improvement in health (Case No. 27 page 557). If the cysts have become infected careful pre-operative treatment will be essential. Correct anatomical positioning to obtain maximum benefit from postural drainage is necessary to achieve this; active assistance from a physiotherapist to loosen the infected sputum by percussion and to obtain its expectoration by encouragement in coughing; short wave diathermy can be a most helpful aid in loosening the sputum. The physiotherapist will also train the patient to breathe and to cough correctly by proper use of the respiratory muscles; it is not sufficiently appreciated that excellent muscular development may not be accompanied by the capacity to do either satisfactorily without training.

A course of estopen penicillin injections will be beneficial. Drainage of infected cystic spaces may be assisted by bronchoscopic suction.

When the cystic disease is widespread in both lungs, or when there is involvement of more than one lobe of each lung, it will be generally agreed that surgery can have no place in treatment. If infection develops in this type of case it will require to be treated as a case of bilateral bronchiectasis (vide supra). The sinuses should be investigated to exclude them as a source of infection but if it is present treatment should be instituted, usually puncture and lavage.

Bronchiolectasis.

This condition is rare and only one case of its kind has been seen in this unit over a period of years. Case No. 30 (page 573), a man of 43 years of age, who had seemingly been in good health until eighteen months prior to admission to hospital, noticed that he was unduly breathless on climbing a steep hill; this became progressively worse until he was admitted to the thoracic unit breathless at all times unless when sitting on a chair or when in bed. He had developed a cough and frothy mucoid sputum. There had been no loss of weight. One brother died of pulmonary tuberculosis.

On examination he was well nourished but slightly cyanosed and breathless. He had clubbing of his fingers. The chest moved equally. The percussion note on the right side was slightly diminished. The breath sounds showed prolonged expiration except at the right base where they were broncho-vesicular. Fine crepitations were heard in both lungs.

X-ray examination of his chest showed the presence of multiple small nodules in the right lower lung field and in the left mid-zone near the hilum (Figs. 87 & 91 page 581, 584).

He was allowed home for a period of 19 days at

Christmas time when he was re-admitted after having caught a chill four days previously. He was then very breathless and markedly cyanosed. Dullness at the right base was noticed; at this area the breath sounds were tubular and accompanied by coarse crepitations. His distress was so marked that he was put on to continuous oxygen. A growth of fungus - candida albicans - was found in his sputum and he was given intensive iodine therapy without benefit. It is interesting to note that his E.S.R. was 4 mm.

A recurrent nerve palsy for three months prior to admission confirmed by direct laryngoscopy increased the difficulty in diagnosis.

His general condition slowly but inexorably deteriorated. Serial X-rays showed progressive increase in the number of small opacities seen in the lung fields until at the time of his death (after six months in hospital) both lungs showed diffuse mottling which at the bases amounted to consolidation (Fig. 88 page 581). His cyanosis and breathlessness became progressively worse and for the last three and a half months of his life he lived day and night on continuous oxygen therapy. If the oxygen was stopped he became rapidly cyanosed and equally rapidly regained his

colour when the oxygen was restarted.

Many and varied diagnostic suggestions were made but none came anywhere near the correct pathological findings of bronchiolectasis. When first admitted his breathlessness and cyanosis in association with his X-ray appearances suggested a dust inhalation disease and this diagnosis certainly gained ground as the opacities increased with the lapse of time. There was no history of exposure to dust inhalation and in any event the opacities seemed to be too large and in some ways too discrete. At this time the fungus was found in his sputum and it was thought that the whole condition would clear with iodine therapy but the progress was in no way checked. By the time both lungs were dotted with diffuse opacities and the appearance of "snow storm" lung had developed the diagnosis of tuberculosis was considered but no tubercle bacilli were found in the sputum and the E.S.R. was within normal limits. Many other conditions were suggested including Hodgkin's disease and reticulosis; pulmonary adenomatosis would also have been considered had one at that time had experience of such a condition.

Cancer was frequently suggested and this

diagnosis was strengthened by the recurrent laryngeal nerve palsy; certainly metastatic cancer seemed a very likely possibility from either a primary cancer elsewhere in the body or from a primary in the lung or mediastinum with retrograde lymphatic spread into the lungs. It was with this diagnosis that he died.

At autopsy both lungs were found to be relatively free of adhesions. Their appearance was practically identical. Both were firm and had surface emphysematous bullae. On section they were dark red, fleshy in texture and honeycombed by multiple cysts (Figs. 89 & 90 page 582, 583). Very few of these cysts were larger than ¼" in diameter and the vast majority were pin head size or smaller. They were lined by epithelium which varied from ciliated columnar to cubical or flattened epithelium, in many the lining was deficient or lost. Between the cysts there was abundant fibrous tissue of long standing. Infiltration by lymphocytes was well marked but there was no evidence of pus formation. There was little or no normal lung tissue left. Dr. Halcrow, who performed the post-mortem, diagnosed the condition as chronic bronchiolitis cystica. Professors Cappell and Lendrum concluded from examination of the specimen and from histological

sections that it was a case of bronchiolectasis and that the appearances indicated that the condition had been present for "at least a considerable number of years".

There seems no doubt that one could argue that this condition was congenital in origin and that it only began to make itself felt once mild infection had occurred. That the infection was mild is borne out by the round celled infiltration. This chronic infection in turn gave rise to the gradual disposition around the cyst walls of fibrous tissue with, in consequence the progressive exclusion and replacement of the remaining healthy lung parenchyma thus increasing the dyspnoea and cyanosis from gradual reduction of available "breathing" tissue. As has been stated the fibrosis had been present for "at least a considerable number of years". Could it not be that over the years slowly but surely more and more fibrosis developed until at the commencement of his illness a mild infection occurred (as evidenced by cough and frothy mucoid sputum) at a time when the balance between adequate and inadequate oxygenation was very finely adjusted? This infection was just sufficient to tip the balance on the side of breathlessness and cyanosis; equilibrium once lost

could never be regained without the artificial aid of oxygen administration; a balance which was finally weighted in the wrong direction by a further chill.

Against the argument that this could be an example of acquired bronchiectasis involving the bronchioles is the widespread distribution of the condition involving both lungs equally and diffusely and the absence of any predisposing factor to account for the development of bronchiectasis. When examining many specimens of lung removed at operation for bronchiectasis I have never seen anything even remotely resembling this condition of tiny cysts so widespread as to involve both lungs diffusely and without favour to one or other.

Pathology and Clinical Features of Emphysematous Bullous Cysts.

The subject of emphysematous bullae was brought up to date by Allison in 1947. He concluded that they were an expression of underlying lung disease, either inflammation or scarring. In consequence during inspiration air enters into the area of the lung supplied by the afferent bronchus or bronchiole more easily than it can escape in expiration. Bullae may therefore arise distal to a bronchus or bronchiole which has become stenosed as a result of disease; the area of lung distal to the stenosis becoming distended in consequence of the valve-like action which the stenosis may produce.

Maier (1941) believes that there is fragmentation of the elastic tissue with rupture of the interalveolar septa; that the changes are usually widespread throughout the lung tending to be more localised around its edge and if confined to one area gives rise to bulla formation. He also describes what he calls pulmonary blebs - in these the air is localised in the interlobular connective tissue just beneath the pleura. They develop as a result of rupture of the alveoli and the escaping air migrates along the tissue planes of the lung - interstitial emphysema.

The bullae are thin walled and may be almost transparent. They are lined partly by collagenous fibrous tissue and partly by cuboidal epithelium. Over-exertion, coughing or shouting causes the inflamed bronchus to rupture, the latter cause was exemplified in Case 5 reported by Allison (1947). This man was an Army physical training instructor who was unable to carry out his duties because he developed pain in his chest when shouting commands.

Characteristically the patients who suffer from emphysematous bullous cysts complain of breathlessness. This symptom is progressive; indeed the cyst formation may be so widespread as to cause death from asphyxia there being insufficient lung left to supply respiratory needs. Case No. 31 (page 586) is an example. A man aged 51 had sustained a gunshot wound of the right chest in 1915 and since then had been increasingly breathless but with little cough or spit during the nine years previous to his admission to the thoracic unit. He was then on continuous oxygen on account of orthopnoea and cyanosis. There was no finger clubbing. The chest was grossly emphysematous and distended and there was practically no movement on respiration. All lung areas were hyper-resonant. The respiratory murmur

was heard only at the left base posteriorly where it was harsh.

The X-rays showed an astonishing picture and one wondered how life was possible. The right hemithorax was completely devoid of lung markings, and all that one could see that might represent lung tissue was a straight edge at the right border of the heart. The left half of the chest was only slightly better, here there was no evidence of lung markings in the upper two thirds of the thorax while in the lower third there was the remains of an almost totally collapsed lung (Fig. 93 page 590).

He was treated by a phrenic nerve crush on the right side which gave some relief to respiration but when two days later a similar procedure was carried out on the left phrenic nerve he became very cyanosed and much more breathless. After he was propped up in the sitting position this gradually improved. One week later he required only half the original supply of oxygen but this improvement was not maintained and by six days later his oxygen consumption had increased greatly.

It is a matter for speculation as to what, if anything, could have been done to relieve so ill a

patient at this stage of his illness. Undoubtedly excision of the bullae and closure of the bronchial leaks on the right side, had he been in better condition, would have allowed the right lung to re-expand. Obviously he was unfit for this, so in an endeavour to do something to improve his condition a de pezzer catheter was inserted into the right side of his chest and connected to an under-water seal drain. On later reflection it would seem that this measure was a mistake, for while the movement of the right lung seemed to improve, seven days later his breathlessness increased and in the evening he became unconscious and died. Although the drainage tube would be quite close fitting in the first few days leakage of air from the cyst into the pleura would commence and probably did so on the day he died, a localised tension pneumothorax being added to his troubles (although it must be admitted that the bulla was partly adherent to chest wall at autopsy; obviously total adherence would prevent a total tension pneumothorax developing). While there are no actual grounds of proof for this belief reference to the experience of Allison (1947) in these cases would lend support to it. In four cases he tried to differentiate

between a local tension pneumothorax and emphysematous bullous cysts and in each he caused a tension pneumothorax by the insertion of the needle, not immediately as one might imagine but one, three, four and seven days respectively after its insertion. More recently Dugan and Sanson (1950) report aspirating tension bullous cysts without ill effects though in case the cyst should burst they are always ready to do a thoracotomy.

At autopsy Case No. 31 (page 586) was found to have a huge bullous cyst in the right lung which filled the chest and which was torn into in freeing its densely adherent attachment to the chest wall. The left lung showed four bullous cysts (Fig. 94 page 591). I preserved the lungs and distended the bullous cysts with preservative. Two of these cysts were each 18 cm. in diameter, a third cyst was 5.5 x 5 cm. and the fourth was slightly smaller. All were thin walled and all were darkly transparent. They were lined in places by flattened epithelium and in places by collagenous fibrous tissue.

Allison (1947) points out that in the less extensively involved cases the degree of breathlessness may be out of all proportion to the size of the cysts.

He belives that this is explained by the Hering Breuer theory of the nervous control of respiration namely that the limits of inspiration and expiration are regulated by tension within the lung structure and that the afferent impulses reach the respiratory centre through the vagi. He further believes that if tension varies in different parts of the lung the greatest area of tension might act as the "governor", and this might be a bullous cyst under tension. This would have the effect of limiting the depth of respiration and lead to dyspnoea on exertion. Case No. 32 (page 593) might be placed in this group. He was a man of 46. At the age of 38 he had pneumonia; at 42 he was breathless at rest and at 43 he had a spontaneous pneumothorax, presumably from rupture of one of his bullous cysts.

On X-ray he was found to have bullous cysts involving the right lower and middle lobes, the largest of these is well seen on Fig. 96 (page 597). It is arising from the posterior and apical portion of the lower lobe. The edge of the bullous cyst on the lung aspect can be seen on the postero-anterior film as a long curving line (a sign first pointed out by Kirklin (1936); another interesting feature is the low level to which the diaphragm has been forced (Fig. 96 page 597).

It was decided to remove this cyst. Anaesthesia was induced with pentothal following which spontaneous respiration ceased and for the rest of the operation the gaseous exchange required to be maintained by artificial respiration through an endotracheal tube. When the chest was opened a large air-filled cyst attached to the apex of the lower lobe was found, opened and dissected out (Fig. 98 page 599). Three small bronchial openings were found to communicate with the cyst and were closed with sutures. Two smaller cysts were found, one of which arose from the middle lobe; both were excised. Unfortunately he never recovered completely from the operation and died 16 hours later. Perhaps his death was due to his inability to withstand the temporary additional respiratory burden caused by the operative procedure on top of a poor respiratory reserve consequent on his basic emphysema. Even at rest he had required to use his accessory muscles of respiration.

The cyst was preserved and distended with preservative and when fixed I found it measured 10 x 7 cm. in size. When it was opened the wall was found to be smooth and shiny except where it was attached to lung there it had a cobweb appearance due to strands of

tissue traversing the cyst, some of these strands passed completely across the cyst. The cyst wall was lined by cubical epithelium on a dense fibrous tissue base.

Treatment of Emphysematous Bullous Cysts.

One sees with fair frequency small bullous cysts with no symptoms. These require no treatment but should be kept under observation in case of increase in size so that they can be treated before the patient is in extremis.

Where the cysts are basal in site and giving rise to symptoms the desired alleviation of symptoms may be gained by crushing the related phrenic nerve. If such alleviation is obtained the phrenic nerve when it regenerates and symptoms recur should be avulsed. Allison (1947) describes two cases in which this was the only treatment required. In one of these he had felt that the diaphragmatic movement was responsible for the maintenance of the tension within a lower lobe cyst. The patient had immediate and complete relief following the operation. He was not advised that the nerve would regenerate and when he reported back five months later with a recurrence of symptoms it was seen that his diaphragm was again moving. This time the nerve was avulsed, thereafter he remained well. The second case was equally successfully treated and this patient was found on the operating table to have increased his vital capacity from 1700 ml. pre-

operatively to 2500 ml. immediately post-operatively.

Allison (1947) believes that when there is a large cyst causing compression and collapse of the lung it should be excised and the bronchus opening sutured. He believes if the lobe in which the cyst lies is also bronchiectatic the treatment should be lobectomy. Case No. 33 (page 601) illustrates this point.

Until one reads the paper by Dugan & Samson (1950) one is apt to consider bilateral bullous cysts as being beyond surgical aid. They state that the patient's condition improves immediately the chest is open for the large bullous cyst will herniate into the wound and allow the underlying lung to expand; also if the condition is bilateral one must be prepared for increased distension of the bullous cysts on the contralateral side and treat it by needle aspiration. Had this been carried out in Case No. 31 (page 586) who had the bilateral disease the result might have been favourable.

Probably needle aspiration of the two apical cysts on the left side followed by right thoracotomy and removal of the enormous solitary apical cyst and segmental resection of the upper lobe would have given a successful result. Before inducing anaesthesia in

patients with this condition is is well to remember that positive pressure anaesthesia courts disaster by causing gross cyst distension and consequent asphyxia before the chest has been opened and freedom for cyst distension has been made.

In considering emphysematous bullous cysts one requires to bear in mind that there is usually underlying emphysema in the older age group of patients and so prognosis should be guarded and a reduced expectation of life anticipated.

Hydatid Cysts of the Lung.

Hydatid cysts are rare in most parts of Great Britain but in certain districts are less infrequent, notably in Shetland and in certain areas of Wales. The following three cases of intra-thoracic hydatid cysts are the only ones observed in this ten year survey.

Case No. 35 (page 612) a banker aged 47, had worked for 27 years in Persia and during the last three or four years of his stay he had had a slight cough accompanied by scanty mucoid sputum; over twelve months he had had several haemoptyses. During an attack of "bronchitis" his chest was x-rayed and an opacity was seen in the right lung; he was then sent home. On admission to the thoracic unit x-ray examination showed a lobulated mass in the anterior segment of the right upper lobe; in the lateral x-ray this mass showed a trefoil appearance (Fig. 104 page 616). The condition was diagnosed as a bronchogenic cyst. At operation the cyst burst and the lining which immediately extruded itself was typical of hydatid. Examination of the fluid showed it to be teeming with scolices. He recovered from the operation but developed a broncho-pleural fistula and subsequently "lattice" lung; anaphylactic phenomena were at first absent but later he became breathless and asthmatic.

Case No. 34 (page 605). A domestic servant, 29 years of age, was admitted following seven weeks of increasing breathlessness accompanied by discomfort in the right chest. X-ray revealed a large spherical mass in the right lower chest. The Casoni test was doubtfully positive. During the operation to remove the right lower lobe within which the cyst lay, the adventitious lining gave way and the cyst escaped intact. Subsequently on several occasions unlimited quantities of apparently crystal clear fluid could be aspirated from the right chest; on one of these occasions after 900 c.c. were aspirated there was still fluid to come. Further x-ray showed that the fluid was being obtained from a second hydatid cyst situated in the superior aspect of the liver. This cyst also was removed later. We should have suspected the association of liver hydatid with the cyst in the right lower lobe as the liver at the time of admission extended to two fingers breadth below the costal margin. Review of the x-rays showed considerable elevation of the right leaf of the diaphragm. She made a good recovery.

Case No. 36 (page 619). This eleven year old schoolgirl had suffered from an irritating cough for some months. She had had a little sputum, but no

breathlessness. X-ray revealed what was thought to be a bronchogenic cyst lying in the superior mediastinum to the right of the trachea (Fig.107 page 622). At operation a cyst 5 cms. x 4 cms. was removed from the right side of the trachea just above the tracheal bifurcation. It was extrapulmonary but adherent to the mediastinal aspect of the right lung. The cyst wall showed dense laminated acellular tissue lined by a syncytium of cytoplasm dotted by tiny nuclei. Hooklets could not be found, but there is no doubt that the cyst is of parasitic origin.

The Incidence of Pulmonary Hydatids.

Barrett & Thomas (1952) in a very comprehensive and authoritative article reported 71 cases of hydatid cyst of the lung most of these having occurred in Wales. A curious feature of the disease is the different sites of infestation and types of population affected in different parts of the world. In Australia the incidence is highest in the sheep rearing districts, whereas in South Wales the people living in industrial areas are more prone to infection than are the farmers (Barrett, 1947). Further, the site of primary hydatid disease also varies, 9% are reported by the French authorities to occur in the lung, whilst in Australia

the lung incidence is reported by some to be as high as 25%.

The three cases in this series were aged 11, 29 and 47 years respectively and comprised one male and two females.

Barrett (1947) found that over half the cases occurred within the second and third decades of life and of these the latter was rather more common. He stated that the sex incidence was exactly equal.

Clinical Features.

In my three cases the duration of symptoms varied from seven weeks to four years. In two, cough was the presenting symptom and one of these had had several haemoptyses. The presenting symptom in the third case was gradual increasing breathlessness accompanied by a dull pain in the chest, both obviously the result of a moderately large cyst (Case No. 34 page 605). Only in Case No. 35 (page 612), was there an obvious association with potentially infected dogs. He had been resident in Persia and several dogs were always present in the house (a normal feature of domestic life in that country). This patient had the longest history, i.e. four years. He had been known for thirteen months to have a shadow on x-ray examination in his lung. In this case and

also in Case No. 36 (page 619) dullness to percussion and diminished breath sounds were noted over the affected area. X-ray examination in Case No. 35 (page 612) revealed a trefoil shadow in the right upper lobe which was diagnosed as a lung cyst. At operation the cyst ruptured during removal, and the nature of the extruded wall and the presence of hydatid sand on it indicated that this was no ordinary lung cyst. Later that day when I examined the fluid under the microscope I saw numerous scolices and many hooklets. He had a stormy convalescence and his wound broke down. Six years later he had become very breathless and asthmatic possibly as a result of sensitisation. In the light of knowledge acquired subsequent to this case it is obvious that an opportunity for more radical and effective treatment has been lost as he has subsequently developed lattice lung and has a broncho-pleural fistula. Treatment should have been supplemented by either closure of the "dead space" and fistula or by lobectomy; unfortunately it is now too late as he is unfit to withstand either method of treatment.

Case No. 36 (page 619) aged 11, showed an unusual x-ray appearance for a hydatid cyst. A small spherical shadow was seen just above the bifurcation of the trachea and between it and the right stem bronchus;

not unnaturally it was diagnosed as a bronchogenic cyst and operated on as such. It was situated as described above and was adherent to the mediastinal aspect of the right lung; in the course of dissecting it from the lung it became detached from the trachea and dropped out free - a pearly white cyst the size of a golf ball. Such a degree of detachability indicated that this was more likely to be a parasitic cyst than one of developmental origin. Reference to the microphotographs (Fig. 109 page 624) shows that the outer wall of the cyst is composed of a dense chitinous laminated structure together with a syncytial lining beset with tiny nuclei; these appearances confirmed that this is a parasitic cyst. Careful search did not reveal any hooklets in confirmation of the diagnosis of echinococcus cyst nor any other feature to enable precise identification to be made. The naked eye and histological appearances are, however, typical of hydatid cyst and Professor Cappell agreed that the structure was not that of a mammalian tissue.

Case No. 34 (page 605) the most recent case was the only one correctly diagnosed and that only partially as the Casoni test was doubtfully positive. This was the case which at operation showed a portion of the

cyst immediately beneath the pleura. The sequence of events during the operation are of considerable interest and they help to substantiate the recent method of removal advocated by Barrett (1949) (see page 123). During the performance of a right lower lobectomy the cyst herniated out of the lobe and lay free and intact in the pleural cavity. The lobectomy was completed and the free cyst was lifted out of the chest. Presumably what had happened was that the area of the cyst presenting on the surface of the lobe had gradually increased in size as a result of the handling during the operation; in other words the manipulation of the lung by the anaesthetist as advocated by Barrett (1949) (page 123). I examined the fluid in the cyst and found scolices to be present, the histological picture of the cyst wall showed the typical laminated chitinous structure. On the sixth post-operative day a needle inserted to tap fluid at the right base withdrew over 900 c.c. crystal clear fluid. That night the patient developed symptoms of anaphylaxis including migraine, aphasia and paresis of face. Five days later aspiration produced a further 600 c.c. of similar fluid. X-ray examination then revealed a fluid level in a hydatid cyst in the superior aspect of the liver. This cyst

was removed seventeen days after the first operation; the patient was discharged well on the nineteenth day thereafter. The presence of a liver hydatid should have been suspected from the beginning for two reasons, firstly the site of the hydatid on x-ray in the right lower lobe obviously related to a raised diaphragm and secondly because on admission the liver was noted to be two fingers breadth below the costal margin. It is possible that the cyst removed from the lung originated in the liver and herniated through the diaphragm into the lung.

Whereas these three cases had symptoms a case of hydatid cyst may be asymptomatic and discovered incidentally on routine x-ray of chest. The presenting symptom is usually cough but if the cyst has recently ruptured the cough is accompanied by watery sputum and haemoptysis, indeed this latter symptom may be the presenting one. If the cyst has attained moderate to large size breathlessness may be the main complaint due to interference with respiratory exchange (Case No. 34 page 605). Pain is commonly a feature and Barrett (1947) believes that this is due to tension in and around the cyst.

Radiological examination will show a shadow

which is usually spherical, but may be trefoil as in Case No. 35 (page 612). A translucent crescent in the upper area of the cyst indicates that partial rupture has occurred and a little fluid has escaped between the laminated membrane and the adventitiae also a little air has entered the space before spontaneous sealing of the small perforation in the laminated membrane occurred. The translucent crescent of air changes its position with movement no matter the position of the patient. This crescent of air is known as "perivesicular pneumocyst" (Barrett & Thomas, 1952). If complete rupture occurs the cyst may empty completely into the bronchial tree and spontaneous cure result (Susman, 1948).

Satisfactory spontaneous cure by coughing up the cyst is by no means free from risk. Thomas quoted by Barrett (1947) stated that 25% of 133 Australian patients who coughed up their cysts died from anaphylaxis, asphyxia due to flooding of the bronchial tree by the cyst contents, haemorrhage or later infection within the cyst.

The x-ray appearances of an empty cyst will be those of an air filled lung cyst. If complete rupture of the cyst takes place but only partial

emptying occurs the x-ray may show portions of the laminated membrane curled up and floating on the surface like a water lily floating on a pond: the so-called "water lily" sign.

If the cyst is near the lung surface it will ultimately present at least part of its periphery on the subpleural aspect of the lung (Case No. 34, page 605) and may then cause adhesions between the two pleural surfaces and even erode the ribs (Barrett, 1947). Ultimately the cyst may drop out of the lung altogether to take up its position in the pleural cavity and there develop a new capsule. In the course of herniating out of the lung it may rupture and produce symptoms of anaphylaxis (Case No.35 page 612) and spontaneous or tension pneumothorax. If it has ruptured the pleura will become seeded with secondary cysts, which grow rapidly (Case 19, Barrett, 1947).

As a last possibility the hydatid may die and ultimately calcify.

No area of the lung is exempt; the right lung is more commonly involved than the left and the lower lobes more often than the upper lobes. Bilateral cysts are not infrequent; Barrett & Thomas (1952) found them in 18% of cases.

Other intrathoracic sites in which hydatids have been found include the pericardium and the heart. D'Abreu (1950) reported a case of a hydatid cyst in the wall of the left ventricle which had a shadow continuous with the cardiac border and which displayed transmitted pulsation. The patient was known to have a hydatid cyst of her spleen; because of haemoptysis (the cause of which was never discovered) it had been thought that the cyst was intrapulmonary. It was successfully removed. He quotes Thomas as having collected 48 cardiac hydatids most of whom died suddenly when the cyst ruptured either into a heart chamber, usually the right ventricle, or into the pericardium.

Susman (1948) advocates completion of the investigation by bronchograms and bronchoscopy, also a preliminary pneumothorax if one wishes to promote adhesions between the visceral and parietal pleura before operating. In my opinion it would seem unnecessary to perform bronchograms at this stage because any bronchiectasis present may well be reversible. Barrett (1947) believes that the lung adapts itself so well to these cysts that irreversible bronchiectasis is unusual. The time for bronchography would appear to be some weeks or months after the cyst

has been removed if the patient still has a cough and sputum so that one may confirm or exclude the presence of a dead space still within the lobe from which the cyst was removed, or the presence of bronchiectasis which has not been reversible.

Bronchoscopy may be helpful in a case in which the diagnosis is in doubt, this would be particularly appropriate in the type of case in which the cyst was as yet comparatively small and in which, in consequence, the exclusion of lung tumour, adenoma or carcinoma was difficult. Bronchoscopy may also be helpful in the ruptured and infected cyst as it will make possible the aspiration of the affected lobe. Susman (1948) was able to extract the hydatid membrane after several bronchoscopic aspirations in one case in which the cyst had ruptured. The patient was well three years later.

Further aids in diagnosis are a raised white cell count (10,000 to 16,000) and an increased eosinophil count of 6% or 8%. The eosinophil count may be raised in the absence of a total leucocytosis.

The complement fixation and Casoni tests may be positive. In four of the cases reported by Logan and Nicholson (1948) in which the Casoni test was performed before operation, there was one positive, two negatives

and one immediate negative but weakly positive delayed reaction. Barrett (1947) has found that the Casoni test must be interpreted in the light of clinical and radiological findings, as he has found it positive on six occasions in patients suffering from some condition other than hydatid disease.

Treatment of Hydatid Cysts.

The mode of treatment to be adopted in hydatid cysts is admirably summed up in these words by Barrett (1947) "the surgical removal of lung hydatids is the ideal and conservative treatment is a policy of despair".

That surgical treatment is the ideal has been generally agreed but precisely what nature that surgical treatment should take is not so generally acceptable.

There are two main schools of thought in the treatment of the univesicular cyst. Logan and Nicholson (1948) from their experience find that removal of the cyst by lobectomy is the treatment which gives the best results. When the cyst alone is removed they have found that the dead space left frequently fails to close; also that bronchiectasis is so frequently co-existent in the affected lobe that a quicker and more satisfactory result is obtained by lobectomy.

On the other hand Susman (1948) expresses the same opinion as Barrett & Thomas (1952) that even large cysts should not require lobectomy. They believe that the local destruction caused by the cyst affects only one lobe segment and not an entire lobe. This conservation of as much lung tissue as possible conforms to the present trend in modern thoracic surgery and would appear to be the ideal method of treatment.

In 1949 Barrett devised a new method of enucleating the cyst with conservation of lung tissue. He re-affirmed the value of this method in 1952 (Barrett & Thomas). A thin rubber bag like a sponge bag with tapes round it is passed over the lobe and the tapes drawn tight round the hilum but not to occlude the vascular supply. Through the bottom of the bag the adventitia of the cyst is incised and the laminated membrane is exposed as wide as its diameter. The anaesthetist inflates the lung repeatedly over the succeeding 10 to 30 minutes during which time the cyst is extruded into the bag, the table is tilted toward the surgeon and the bag is emptied into a dish. The bronchial fistulae which are constantly found opening into the "empty space" should be closed individually

"and the sac obliterated by a series of purse-string sutures inserted seriatim from the bottom to the surface of the space". They find that the space remains closed in the majority of cases, in a minority the space may remain open ultimately being lined by epithelium thus becoming an air filled lung cyst which may or may not evoke symptoms. If the hydatid cyst was large they advise excising the adventitia and closing the main segmental bronchus leading to the fistulae. They believe that no matter how large the cyst may be that only one segment of lung is involved and therefore only one segmental bronchus is ruptured.

Case No. 34 (page 606) illustrated the ease with which this method could be used successfully. In this case the hydatid cyst was actually presenting an area the size of a florin on the external lung surface and and during the manipulations necessary to perform a lobectomy the cyst actually herniated out of the lobe and fell intact into the chest. If instead a bag had been applied over the lobe and the adventitia incised for a short distance on either side of the presenting surface of the cyst it would certainly have herniated as Barrett (1949) described.

Case No. 35 (page 612) corresponds to the type of case in which the residual space in the lung persists after the cyst has been removed. This patient ought to have had a lobectomy to complete his treatment before he developed asthma and emphysema.

The simple evacuation of the cyst contents and suture of the adventitia to the chest wall in the uncomplicated hydatid cyst would now appear to have no place in treatment, indeed it is a method not without risk as air may escape from the raw lung surface into the pleural space and give rise to a tension pneumothorax.

For bilateral simple cysts bilateral thoracotomy at a suitably placed time interval appears to be the accepted treatment. Barrett (1947) gives a warning that by the time of the second operation the patient may be sensitised even although only a small quantity of fluid has been spilled at the first treatment. This complication is apparently infrequent.

Ruptured and infected cysts may be treated either by removal of the cyst contents and wall, the "space" being marsupialised and drained (with additional separate drainage of the pleura) or by lobectomy.

Susman (1948) favours the former method.

Barrett & Thomas (1952) favour the latter if the lobe is extensively diseased; if it is not and the patient is young and in good condition they prefer incision and drainage with removal of the abscess contents. Those cases in which drainage alone has been carried out and in whom the lobe is extensively diseased are liable to develop permanent sinuses and "lattice lung" (Case No. 35 page 612 developed these complications).

If cyst fluid escapes at the time of operation daughter cysts may develop. Barrett (1947) mentions an interesting case of daughter cysts the size of "pearl beads" which appeared in the mouth on coughing and sneezing and which "popped like seaweed when squeezed". The patient had had a primary hydatid removed intact five years before in New Zealand. She was operated on twice by Brock and apparently cured.

Dead hydatid cysts should be regarded as dangerous foreign bodies in the lung (Barrett, 1947). When the cyst dies its disintegration causes inflammation in the lung round about; ultimately much fibrosis and even dense calcification may occur.

Castex and Copdehourat (1950) encouraged by the

good results they obtained using intrapulmonary injections of antibiotics in broncho-pulmonary suppuration began to use a similar method of treatment for infected hydatid cysts and finding this method successful they extended its use to uninfected ones. In infected cysts they injected sulphonamides and the appropriate antibiotics and claimed that the resultant irritation produced coughing which in turn loosened portions of the endocyst and led to expectoration of its fragments. In uncomplicated cysts they first desensitised the patient, then produced pleurodesis over the site of the cyst which was ultimately sterilised by formalin injection and emptied; the cyst wall was then treated by injections of digesting fluid containing pepsin and hydrochloric acid. These injections usually require to be repeated for at least three months. While this method of treatment seems to be successful, in these times of modern chest surgery and anaesthetic methods I feel that operative treatment is more certain and will greatly reduce the period of invalidism.

Haemangioma of Lung.

In my series there was only one case of haemangioma of lung. It occurred in a male patient who had multiple telangiectasis of the skin and of the buccal and bronchial mucosa. This case would appear to have considerable resemblance to the syndrome of hereditary haemorrhagic telangiectasis described by Rindu, Osler and Weber. A number of cases with this syndrome have had pulmonary arterio-venous aneurysms.

Case No. 37 (page 625) a 43 year old joiner gave an eleven months history of loss of energy and loss of weight accompanied by tightness across his chest. After three months he began to cough up blood stained sputum and a month later he had a haemoptysis amounting to two pints. He was admitted to Ballochmyle Hospital in a critical condition. No cause was found for the haemoptysis and he was discharged home. He had a further haemoptysis and was admitted to the thoracic unit. On examination he was found to have multiple telangiectatic spots on his face (particularly around his mouth), and on the buccal mucous membrane. X-ray revealed a number of small, circumscribed, rounded opacities in the left lower lobe. Bronchoscopy showed numerous submucous angiomatous vessels in the bronchial

walls. An angiomatous mass, pulsatile and transmitting a thrill, was excised from the left lower lobe. He made a good recovery and had no further haemoptysis.

The Historical Features of Haemangioma of Lung.

Bowers (1936) reported the first case; a two day old boy who died as a result of intrapleural haemorrhage and in whom multiple haemangiomatous masses in the lungs were found at autopsy. They also quote the second case reported by Rodes of a man of 25 who died of haemoptysis, at post mortem multiple haemangiomata were found in the right lower and middle lobes and in the left upper lobe. Smith & Horton (1939) made the first diagnosis during life and Shenstone (1942) first successfully removed a lung for this condition in 1940. Hayward & Reid (1948) found records of 28 cases diagnosed during life and added one of their own; twenty-one of these had been operated on.

Pathological Features.

Haemangioma of the lung is part of a more or less generalised condition of telangiectasis and is a wide peripherally placed communication between a venalised tortuous pulmonary artery and a corresponding pulmonary vein. Hayward & Reid (1949) found that in their

specimen the major lesion consisted of a thin-walled dilated and tortuous pulmonary arterial branch opening into a single large peripheral cavity which in turn drained by wide openings into two pulmonary veins. In spite of its huge size, the communicating cavity between artery and veins occupied the same position in relation to these as do the capillaries which are present in normal lung. The arterial branch concerned in the lesion from its origin to its termination in the peripheral cavity was abnormally wide, long and thin-walled; but the veins showed less variation from normal apart from their unusual origin in the sac and their increased diameter to accommodate the greater volume of blood flowing through them. Their walls were of normal thickness and their length only slightly increased.

Whitaker (1947) reported two cases, only one of which was operated on; in it he found the veins very thin, their walls being only 30 to 40 u. in places.

Hayward & Reid (1949) stress the importance of recognising that a large lesion of this nature is only one manifestation and that many small dilated vessels are to be found in the adjacent lung tissue, in other words "the large arterio-venous communication is not a circumscribed condition as at first sight it appears to

be but a localised exaggeration of a more diffuse process". They believe that these small vessels are dilated pulmonary arterioles and their communications with corresponding venules. They compare them to telangiectasis of skin and mucous membranes.

Clinical Features.

Admirable accounts of the clinical features of haemangioma of the lung are described by Jones & Thompson (1944) and Maier et al (1948). Quite frequently these cases have been diagnosed as having congenital heart disease because of the cyanosis and clubbing of the fingers and toes. It is not until X-ray examination of the chest has revealed a tumour of the lung or a continuous exocardial murmur that the true condition is recognised. Compensatory polycythaemia is always present and its degree is an indication of the size of the arterio-venous communication. A striking feature is the normal cardiac shadow with no signs of hypertrophy because the lesion is entirely pulmonic in site. In about half the cases over the area of anastomosis there is a moderately loud rough, roaring murmur which is often continuous, most marked at the end of systole and the beginning of diastole and increased in intensity at the

end of deep inspiration. On X-ray there is a rounded or irregular shadow seen in the lung field; it does not appear to alter in size with the passage of time. During inspiration it increases and during expiration it decreases. On plain X-rays it looks solid but is actually a branching mass sometimes worm-like in character connected to the pulmonary arterial branches. Angio-cardiography confirms the diagnosis and Maier (1948) recommends that this method of investigation be carried out in all cases of suspected haemangioma for in this way multiple arterio-venous communications not seen on routine X-ray investigation will be demonstrated. Maier (1948) reported a case which had bacterial endocarditis in the arterio-venous fistula; the case was successfully treated by chemotherapy and subsequent lobectomy.

When the diagnosis has been established with reasonable certainty the decision for operation may be determined by the degree of anoxaemia present and by the secondary effects such as polycythaemia or if there is severe haemoptysis as in my case. Hayward & Reid (1949) believe that if these conditions are present and causing disability and if it is felt that operation will relieve these disabilities then it should be carried out.

With increasing knowledge of this condition, other factors should be taken into consideration even in the absence of gross anoxaemia and polycythaemia. Thus Rodes (1938) reported a case of rupture of the arterio-venous communication and Jones & Thompson (1944) found the wall of the venous component of their specimen so thin that they felt it could have been ruptured by a blow on the chest. Thrombosis would be a constant danger in the presence of a marked degree of polycythaemia. While bacterial infection is also a risk.

Operative Treatment of Pulmonary Cavernous Haemangioma.

As a rule some form of resection is required in cases of haemangioma. Cleland (1948) found an enormous dilatation of the pulmonary artery and vein to the lower lobe; in consequence, to remove the haemangioma, lobectomy was required. Further, other vascular congenital anomalies of the lung must be borne in mind, for example, Jones & Thompson (1944) found it necessary to perform a pneumonectomy in their case because there was no superior pulmonary vein; removal of the lower lobe with ligation of the inferior pulmonary vein would probably have led to necrosis of the upper lobe and loss of its entire functioning capacity.

On occasions it may be found possible to dissect out the lesion and conserve the lung tissue. In July 1951 I saw Crafoord in Stockholm carry out just such an operation with his usual consummate skill. The haemangioma was in the middle lobe and I fully expected him to perform a middle lobe lobectomy but by dint of careful painstaking dissection he was able to enucleate it from the middle lobe and at the conclusion of the dissection he was left with a comparatively small communication between one of the pulmonary artery branches with one of the pulmonary veins of the middle lobe. He was

thus able to conserve the lobe which appeared to have good function. Obviously it is by no means always possible to achieve complete removal of the haemangioma and preserve the lung tissue in this way.

The case in my series survived the operation and had no further haemoptysis.

Hayward & Reid (1949) found two operative deaths reported in 29 cases submitted to operation.

Bronchial Adenoma.

This interesting group of tumours was represented by 9 proved cases and 3 which were unconfirmed.

Case No.45 (page 696). This 42 year old domestic servant had been breathless on exertion for 20 years; for 6 years a ticklish cough had been present. Two attacks of so-called pneumonia occurred, the first two years and the second one month before admission to the thoracic unit. Bronchogram revealed incomplete obstruction of the right stem bronchus just above the middle lobe bronchus. Bronchoscopic biopsy tissue taken in Aberdeen before admission was reported as oat-cell carcinoma. Pneumonectomy was carried out and the diagnosis was confirmed by an inexperienced pathologist. Three years later she was admitted to Perth Royal Infirmary for some other condition. She was so well that a report was sent to the thoracic unit telling of her good health. I re-examined the specimen and the histological sections and found that she had an adenoma and not a carcinoma.

Case No. 41 (page 659). For 11 years this 46 year old woman had had a cough with haemoptysis every three or four months. For 10 years she was known to have an opacity in the right chest which had altered little in size. An adenoma was seen on bronchoscopy

projecting from the middle lobe bronchus. The tumour was removed along with the middle and lower lobes. She made a good recovery.

Case No. 40 (page 649). Every six months for 26 years this 49 year old housewife had attacks of haemoptysis; for three years she was known to have a simple tumour in the right lower lobe. Shortly before admission she had several large haemoptyses following one of which she fainted. The tumour was seen and diagnosed on bronchoscopy. It was removed by lower lobe lobectomy and proved to be an adenoma. She made a good recovery.

Case No. 43 (page 680). This 49 year old female patient had recurring haemoptysis for ten months. Bronchoscopy revealed an adenoma in the right lower lobe bronchus. X-ray of the chest following one brisk haemoptysis revealed an increase in opacity in the lobe probably due to aspiration of blood. The tumour and right lower lobe were removed. She made a good recovery.

Case No.39 (page 641). A housewife, aged 51, for two years had recurring attacks of what appeared to be pneumonia with occasional haemoptysis. X-ray revealed collapse of the right lower lobe and bronchoscopy showed an adenoma in the right stem bronchus. The tumour was removed along with the middle and lower lobes,

both lobes were atelectatic having been blocked by the tumour which had no extrabronchial extension. She made a satisfactory recovery.

Case No. 44 (page 688). A motor driver, aged 39, two months before admission to the thoracic unit developed what was thought to be influenza following which he had a haemoptysis of one pint of blood. He was bronchoscoped in another hospital and the biopsy specimen was reported as oat-cell carcinoma. Bronchoscopy was repeated when he was admitted to the thoracic unit and an adenoma was seen and removed. Subsequently lobectomy was carried out and complete removal of the tumour at bronchoscopy was confirmed. He made a good recovery.

Case No. 38 (page 631). A 59 year old woman, for six months had pain in the left chest, lassitude, cough and spit, but no haemoptysis. She was bronchoscoped in another hospital and the biopsy tissue was reported as oat-cell carcinoma. A pneumonectomy was carried out; subsequent examination revealed a polypoidal tumour blocking the stem bronchus. The tumour was an adenoma. She made a good recovery.

Case No. 43 (page 669). This 30 year old woman had attacks of pneumonia five and three years before

admission to the thoracic unit. Nine months before admission a pleural effusion was found. Two months before admission the effusion was found to be due to sterile pus. It had caused complete lung atelectasis and it was lying in a space which had a slightly positive pressure. Several attempts were made to aspirate air and re-expand the lung but these were unsuccessful. Bronchoscopic examination revealed an adenoma. Two more bronchoscopic examinations were carried out and further tumour tissue was removed but lung re-expansion did not occur. Pneumonectomy was performed and a large tension lung cyst of the upper lobe was found. The fluid and subsequent sterile pus had apparently been aspirated from the cyst and not from the pleura. The specimen showed an adenoma 1 x 1.5 cm. blocking the stem bronchus above the origin of the upper lobe bronchus. The cyst was 12 x 10 cm. in size; it had at least three communications with the upper lobe bronchi. She made a good recovery.

Case No.46 (page 703) a female, aged 38, developed a chest cold and had had several haemoptyses two months prior to admission to the thoracic unit. Examination revealed dullness at the right lung base. X-ray examination showed a rounded solid shadow at this area.

She was operated on and the tumour along with the right lower lobe was removed. It was found to be 5 cm. in diameter. There was some doubt as to the exact diagnosis but it was thought to be an adenocarcinoma. She made a satisfactory recovery but died five years later from a carcinoma of breast. On reviewing the case and taking into account her subsequent good health it would seem that it was an adenoma and not an adenocarcinoma.

Historical.

Bronchial adenoma was first described in post-mortem material in 1882 by Mueller. According to Goldman & Conner (1950) the condition continued to be diagnosed only at post mortem until 1930, in that year the bronchoscopic recognition and bronchoscopic treatment during life commenced with the correct diagnosis by Kramer. This phase remained as the only approach to the problem and its treatment until 1938 when Hemperl introduced the more radical and much more conclusive method of treatment by pulmonary resection in conformity with the more complete understanding of the lung damage which results in many of these cases from bronchial blockage.

Incidence & Etiology.

Sanders & Kingsley (1948) found the incidence of adenoma of the bronchus at the Lahey Clinic to be 6.9% of all proved bronchial tumours. The origin of these tumours favoured by most authorities is that they arise from the epithelium of the mucous glands and ducts of the bronchi (Brunn & Goldman 1941). It would seem that whereas in bronchial carcinoma the usual site of origin is in the bronchial epithelium, in adenoma this is never the cell of origin and in this way adenoma

resembles fibro-adenoma of breast having origin from the acini while carcinoma arises from the duct epithelium. Carcinoma may arise and often does in smaller bronchi, adenoma seldom if ever takes origin distal to the main lobar bronchi.

This latter feature could be used as an argument in favour of Womach & Graham's view of origin. They put forward the very reasonable view that adenoma arises as the result of failure of a bronchial bud to develop into the orderly arrangement of tissues found in normal lung; any such tissue will obviously be associated with and remain intimately connected to the stem bronchus. When mesodermal elements preponderate they believe that chondroma, lipoma and fibroma will occur and when entodermal elements are in the majority that an adenoma will result. In support of this view they hold that adenoma is difficult or impossible to differentiate from foetal lung. In further evidence they have shown that other anomalies may be present in these cases including absence of or excessive lobulation and congenital cystic disease. When I visited Dr. Graham at his clinic at the Barnes Hospital, St. Louis in September 1951, he was still in favour of this view and he showed me specimens of two cases in which there

was a carcinoma and a sarcoma growing side by side; this was held to support the theory of failure in the development of part of a lung. His explanation of this rare association in the realm of tumours was that it had occurred where a bronchial bud had failed to develop and the mesodermal and entodermal elements had undergone simultaneous malignant growth.

Mallory (1946) believes that adenomata are similar to carcinoid tumours of the appendix having slowly growing cells with affinity for silver stains. Several cases in this group were studied by Dr. Hutchison of the Western Infirmary and myself in an attempt to determine whether the general histological resemblance to the carcinoid tumours was accompanied by an argentaffin reaction and other histochemical similarities. In no case could we confirm Mallory's findings, and we therefore concluded that the resemblance was only superficial.

Pathology.

Bronchial adenoma is a tumour of slow growth almost invariably arising in relation to a stem bronchus of a lobe or lung; consequently it was seen on bronchoscopic examination in every one of the 8 cases bronchoscoped.

Moersch & McDonald (1950) reported that the tumour was seen in 91% in a series of 84 patients at the Mayo Clinic.

The gross characteristics of these tumours are so typical that the bronchoscopist at the time of examination can often suggest the diagnosis of adenoma. The picture seen is the partial or complete occlusion of a stem bronchus to a lung or lobe by a lobulated pink, red or purplish mass which is firm to touch and bleeds readily. The surface of the tumour is smooth because as a rule the bronchial mucosa is intact over the tumour and has not ulcerated, though ulceration may develop and squamous metaplasia may occur. An important feature not fully appreciated in the early days of treatment was that the tumour resembled an iceberg floating in water in that the visible portion was much smaller than the portion lying within the lung substance but outside the bronchus. While it is true that a very few adenomata have no extrabronchial extension (Case Nos. 38 and 39 page 631, 641) it is the exception rather than the rule. Such tumours will probably have a narrow pedicle and so be freely movable and thus be readily excised through the bronchoscope unless they have reached a large size. The more usual tumour

might be likened to a dumb-bell. It has a small intrabronchial portion joined by a narrow neck of tumour which passes through between the cartilaginous rings to the main mass lying in adjacent lung tissue which is compressed around it (Case No. 40 page 649). It is therefore quite impossible in these cases for the bronchoscopist to tell how large the tumour really is.

If the adenoma blocks partly or completely the bronchus into which it projects the lung distal to the obstruction will show pathological changes of varying severity. Such obstruction may cause segmental or lobar atelectasis (Case Nos. 39 and 41 page 641, 659). Subsequent stagnation of the secretion will lead to superadded infection and will give rise as a common sequel to bronchiectasis (Case No. 38 page 631) and lung abscess.

A feature I have not found published in other series of cases occurred in Case No. 42 (page 669). On the superior aspect of the lung there was a giant tension cyst measuring 12 x 10 cm. in size. I found in the cyst three bronchial openings which had communication with the upper lobe bronchus. The cyst lining was smooth, shiny and pale blue in colour. It is interesting to report that neither the clinicians nor

the radiologist diagnosed the condition as a cyst, all thought there was a pneumothorax with a concomitant effusion. For 5 years she had been frequently admitted to a sanatorium as a case of tuberculous effusion but this was never proved; indeed not only was the fluid tapped on several occasions and found to be serous in character but attempts were made to re-expand the collapsed lung by withdrawing air from the "cyst", as much as 3,000 c.c. of air being removed on one occasion. As one would expect in view of the bronchial communications this had no effect.

In the 9 proved cases of adenoma, 7 were in the right lung and 2 were in the left. This preponderance of right lung over left is a frequent feature in published series, although the discrepancy between the two sides is not usually so marked. Moersch & McDonald (1950) had 47 right tumours as against 38 left ones. Four of the 9 specimens were in the stem bronchus, three in the lower lobe bronchus and one in the middle lobe.

Although Baldry (1952) reported 9 cases of carcinoma of the middle lobe bronchus from a series of 185 (5%) this figure is somewhat higher than other reports and it is generally agreed that carcinoma of

the middle lobe is uncommon. On the other hand one has the impression from the literature that adenoma of the middle lobe bronchus occurs rather more frequently than does carcinoma. Case No. 41 (page 659) occurred in this site. Moersch & McDonald (1950) had three instances in a series of 86.

Adenoma seen through the bronchoscope shows up as a pink or red, lobulated tumour but when the tumour is sectioned after removal it is usually greyish white in colour and its lobulated appearance is maintained by strands of fibrous tissue running throughout its substance (Fig. 120 page 655). The largest tumour occurred in Case No. 40 (Fig.120 page 655) and was 6 cm. x 4.5 cm. in size. As might be expected, this was the case giving the longest history, namely 26 years. This tumour appeared to be invading bronchus at one point and this may have accounted for the marked increase in symptoms shortly before admission to hospital. These included three large haemoptyses, following one of which she became unconscious. A further interesting feature of this case was the presence of a small grape-sized congenital cyst in the lower edge of the lobe.

The specimens removed from those cases in which

the tumour projected into the lung substance showed that tumour growth had displaced and compressed the lung tissue before it in such a way as to ensheath the tumour and give the appearance of a false capsule (Case Nos. 40, 41, 43 page 649, 659, 680). Case No. 41 (page 659) in which the tumour was in the middle lobe illustrates these features particularly well. The tumour had been seen on x-ray 10 years previously but no noticeable change in size had occurred in spite of recurring attacks of haemoptysis every three or four months for the first 8 of these years. At bronchoscopy the tumour was seen to project into the stem bronchus from the middle lobe orifice and it was partly obstructing the main lower lobe bronchus. Figs. 125 & 126 page 665, 666 illustrate this projection of the tumour; indeed the projection was so marked that at operation it was found necessary to remove the lower lobe as well as the middle lobe, indeed some difficulty was encountered in leaving sufficient stem bronchus behind so that the closure would not encroach on the upper lobe orifice. Although lipiodol X-rays show no bronchiectasis it will be seen from the photograph of the specimen that there are present early bronchiectatic changes (Fig. 127 page 667). The tumour had reached such a size that there was only

a thin layer of the middle lobe left surrounding the tumour. This case is a good illustration of the impossibility of completely removing the tumour by bronchoscopy; even if it had been possible to do so, only grossly diseased lung tissue would have been left behind, tissue which could never have regained any useful function.

In Case Nos. 38, 39, 44 and 45 (page 631, 641, 688 & 696) the tumours were examples of intrabronchial adenoma having little if any extrabronchial extension. Of these two had narrow pedicles of attachment to the bronchial wall and in one it was possible to remove the tumour through the bronchoscope (Case No. 44, page 688). All of these cases illustrate the damage that accrues from partial or complete blockage of the bronchus by the tumour, all showed varying degrees of bronchiectasis, the most marked being Case No. 38, (Fig. 113). The changes were sufficiently marked in all to require the removal of the affected lung tissue by lobectomy or pneumonectomy. The two polypoidal examples with broad bases of attachment to the bronchial wall were both subjects of errors in diagnosis. Case No. 38 (page 631) was incorrectly diagnosed as an oat-celled carcinoma from the tissue removed at

bronchoscopy but correctly diagnosed from the post-operative tissue; Case No. 45 (page 696) was originally diagnosed as an oat-celled carcinoma until three and a half years later doubts were raised by the receipt of a report from Perth Royal Infirmary stating that she was well. On reviewing the specimen and the histology I found that the tumour had been an adenoma. Fig. 143 (page 701) showing the gross specimen should clearly raise doubts in the expert's mind that this could have been a carcinoma, the polypoidal nature of the tumour and the absence of invasion beyond the bronchus wall are quite contrary to the usual appearance of carcinoma. Had further evidence been required it was to be found in the history of breathlessness for 20 years accompanied by a ticklish cough for the last 6 years of this period.

Histology.

The common histological picture shows closely packed cuboidal or columnar cells one or more layers in depth surrounding a central space of varying size. The cell nuclei are round or oval and either show dense nuclear chromatin or are vesicular and have small dense nucleoli; characteristic of each specimen was the uniformity of the cells (Case No. 41 page 668).

Mitotic figures are rarely seen. The pattern in the tumours presented here is of a more solid nature frequently with solid acini but in others the cells may be grouped more erratically in sheets, cords or columns with little, if any, tendency to the formation of intercellular spaces, but the arrangement is still regular in that there is no evidence of "unruly" growth (Case No. 41 page 668). The stroma may be abundant and is richly supplied with capillaries (Case No. 40 page 657). The tumour is covered by the normal ciliated columnar epithelium of the bronchus and is separated from it by a layer of connective tissue (Case No. 44 page 695). Sometimes ulceration of this epithelium occurs with consequent interruption of this lining, and if the infection persists squamous metaplasia may occur.

There was no evidence of metastases to lymph nodes or to other sites. The only feature of danger occurred in Case No. 40 (page 649) which was looked on as showing commencing invasion in a tumour of long standing. In one area the tumour was seen reaching up to a bronchus the basement membrane of which was ruptured. Several cases have been reported in the literature in which malignant invasion of a bronchus has occurred and in

some there has been invasion of lymph glands.

Clinical Aspects.

Unlike carcinoma of lung, adenoma occurs much more frequently in women than in men, the incidence in this series was 8:1. The age distribution in adenoma is usually below 40 and often between 20 and 30. Sanders & Kingsley (1948) reported a case aged 13. In carcinoma, on the contrary, it is most commonly over 40. The age incidence here is higher than usual the average age is 44, the oldest being a female of 59. A further distinguishing feature from carcinoma is the unusually long duration of symptoms along with the maintenance of comparatively good health, (Case No. 40 page 649).

Because the adenoma projects into a moderate to large size bronchus cough is the most frequent symptom. It may be dry and unproductive or be accompanied by frothy mucoid sputum. Haemoptysis in recurring episodes is nearly as common a symptom as cough. It may occur as periodic simple streaking of the sputum or it may be quite profuse in character and sufficiently exsanguinating to cause unconsciousness (Case No. 40 page 649). Haemoptysis was present in 7 of these cases;

it occurs at varying intervals and quite frequently months and even years may elapse between the attacks.

Other symptoms associated with adenoma arise as a result of obstruction to the bronchus in which the tumour lies. Thus complete occlusion of the bronchus will lead to atelectasis of a segment or of the entire lobe and this gives rise to dyspnoea varying in proportion to the amount of lung tissue involved. The x-rays of Case No. 40 (page 654) show segmental collapse involving the middle segment of the right lower lobe, while Case Nos. 41 and 39 (page 664, 646) are examples respectively of middle and lower lobe collapse. Atelectasis and bronchial obstruction may cause pain in the chest and if infection is superadded fever will occur and the finding on examination of consolidation leads to an erroneous diagnosis of pneumonia; if this incident is repeated, the case is then thought to be one of recurring pneumonia. In time the atelectatic lobe may become grossly infected and all the symptoms of bronchiectasis are superadded.

X-ray examination may show a shadow usually near the root of one lung, with distal to the shadow, atelectasis of a segment or lobe of the lung (Case No. 41, page 664). This shadow is usually circumscribed and well defined but it may be partially or completely

obscured by the area of atelectatic lung (Case No. 40 page 654). Lipiodol instillations may be of help in outlining a blocked segment of the bronchial tree. This is particularly well seen in Case Nos. 40, 41 and 42, (page 654, 664, 675).

Final and conclusive diagnosis can be made only on bronchoscopy when the tumour is seen. If the tumour has a narrow pedicle it will be freely movable. When biopsy is taken the tumour cuts crisply and may bleed freely owing to its abundant vascular supply. Biopsy tissue taken at bronchoscopy requires interpretation by an experienced pathologist for not only is the tissue minute but the cells may be distorted into an uneven and irregular appearance by the pressure of the biopsy forceps giving a picture resembling oat-cell carcinoma rather than adenoma. Indeed in three of the cases this was the diagnosis given from the bronchoscopic tissue; in Case No. 44 (page 688) a further pre-operative bronchoscopy established the correct diagnosis; in Case No. 38 (page 631) the diagnosis was corrected on examination of the post-operative specimen; but in Case No. 45 (page 696) it was not until 4 years after pneumonectomy that a further review of the histology proved it to be an adenoma, and in Case No. 46 (page 703) review after

five years corrected the diagnosis. In the other 5 cases the correct diagnosis was reached. In 86 consecutive cases at the Mayo Clinic, Moersch & McDonald (1950) saw the adenoma on bronchoscopy in 78 and in these a positive biopsy was obtained in 96%. In view of the difficult interpretation of the histology it is as well to warn the pathologist that an adenoma is suspected.

Differential Diagnosis.

The condition most likely to cause confusion is bronchial carcinoma. The long history without marked deterioration of the patient's general health; the comparatively early age at which adenoma usually occurs and the characteristic bronchoscopic findings should all favour the diagnosis of adenoma. In the differential diagnosis one has to consider such conditions as "recurring" or "unresolved" pneumonia, a lung abscess as yet unruptured into a bronchus giving on x-ray a solid spherical shadow, usually however more peripherally situated than an adenoma (Case No. 111, page 1233). In short, the conditions are very similar to those requiring consideration in the differential diagnosis of carcinoma.

Treatment.

Of the 9 adenoma treated surgically, one was successfully removed through the bronchoscope but subsequently required lobectomy to remove diseased lung tissue. Three others were adequately dealt with by lobectomy and two required removal of both middle and lower lobes. The remaining three cases required pneumonectomy but in two an erroneous diagnosis of oat-cell carcinoma had been made. Lobectomy might have been sufficient in the light of the correct diagnosis and in reference to the specimens (Case Nos. 38 and 45, page 639 and 701). Eight of these cases are alive and well, the longest survival is 10 years and refers to the oldest patient, a woman who was 59 years of age at the time of the operation (Case No.38, page 631). One died of breast cancer five years later.

The diagnosis apart pre-operative bronchoscopy is of great value. It finds the exact location of the tumour and if a large part of the obstructing tumour is removed drainage from the obstructed lobe will be established and any acute pulmonary suppuration will subside before operation.

The line of treatment adopted will depend on the age and general condition of the patient. Radical

treatment by surgery is the generally accepted method of choice but in an elderly patient or in one of poor general condition all that may be attempted may be simple removal by bronchoscopy of the intrabronchial projection of the tumour. In a healthy patient this method of treatment would seem to be permissible only rarely where the adenoma is entirely intrabronchial, has a narrow pedicle and there is no evidence of distal bronchiectasis. If this method is adopted the patient must thereafter be bronchoscoped at regular intervals for years. Initially, a repeat bronchoscopy would be carried out in one month's time and if no recurrence was seen at increasing intervals up to six months or one year. If this precaution is not taken and the undeniable risk of recurrence is ignored the patient will be in danger of developing unsuspectingly an ever enlarging tumour which may well lead to the development of atelectasis and bronchiectasis or may undergo malignant invasion. The necessity for these repeated examinations is well illustrated by a case of Clagett & Payne (1946). A man of 35 years had an adenoma removed endoscopically from the right lower lobe bronchus. Two years later he reported well; he was x-rayed and no recurrence was seen. A further

3 years elapsed when he reported with a cough and sputum and a recurrence of the tumour was found. He refused lobectomy and it was again removed through the bronchoscope and radon seeds were implanted. He remained well for a further 5 years when the cough recurred and he developed haemoptysis. He was again bronchoscoped and the right stem bronchus was found to be obstructed by tumour tissue and there was bronchiectasis of the middle and lower lobes. On this occasion the right middle and lower lobes were removed and showed marked bronchiectasis, pneumonitis and fibrosis. The adenoma was 3 x 2.5 cm. in size and almost entirely extrabronchial.

In the vast majority of cases more radical surgical measures are required. As the obstructing factor will have been present in greater or less degree for many years, the bronchiectasis usually present is unlikely to be reversible, indeed many of the lobes removed have shown areas of well marked fibrosis which would render impossible the re-establishment of useful function. As a result it is nearly always desirable to remove the adenoma and the affected area of lung distal to the tumour. Usually this can be effected by lobectomy but on occasions the tumour may be so placed as to

necessitate pneumonectomy (Case No. 42 page 669). If the biopsy tissue is reported as belonging to one of the more malignant groups of adenoma, particularly a cylindroma, pneumonectomy is the only treatment likely to save the patient (Van Hazel, Hollinger & Jensik 1949).

A good recovery from a successful radical surgical procedure for adenoma usually implies freedom from recurrence or further trouble as the result of the tumour.

In the Massachusetts General Hospital series Harrington et al (1946) reported 88% of adenoma cases alive and well from 3 - 5 years after surgical removal. If the adenoma is of the cylindroma group the prognosis on account of the development of recurrence is much less favourable, being reduced by 50%.

It is as well to remember to bronchoscope the patient at the end of the operation as not only blood and pus may have escaped into the healthy lung but portions of adenoma may have broken off and passed over the carina into the other bronchus. Clagett & Payne (1946) in one case removed from the healthy bronchus a portion of adenoma 2 x 0.5 cm.

Conclusion.

At one time adenoma of the bronchus was looked upon as an extreme rarity, indeed Dick (1950) was unable to find an example of this type of tumour in the post-mortem records of three large Glasgow teaching hospitals, and yet here in one surgical thoracic unit are nine proven cases occurring in the space of ten years. Dick (1950) reports eleven personal cases including the nine here described. It seems that advances in radiography and the advent of bronchoscopy and latterly surgical exploration will bring an ever increasing number of adenoma tumours to light.

In former years it is probable that these cases either died at home under the mistaken diagnosis of unresolved pneumonia or carcinoma or that they died in sanatoria erroneously diagnosed as cases of tuberculosis.

Pulmonary Adenomatosis.

In my series, there was one case of pulmonary adenomatosis, reported in the British Journal of Surgery (1953) by H.E. Hutchison and myself. A woman of 36, six months prior to admission to the thoracic unit, had begun to feel tired and to lack energy and after three weeks she developed a shivering attack during which a bout of coughing produced much frothy sputum. She went to bed and for four weeks suffered continuously from fever, pain in the right lower chest on deep breathing and a cough accompanied by white frothy sputum. In spite of treatment she made only a partial recovery from this illness, the cough, spit and chest pain persisting. She was admitted to the I.D. Hospital, Dumbarton, and six weeks later she was transferred to the thoracic unit, at which time she was producing two to three cupfuls of white frothy sputum daily (18-20 oz.) - the sputum "welled" up quite freely all day. There was limitation of movement, impairment to percussion, bronchial breath sounds and many fine crepitations over the right lower lobe, but neither cyanosis nor finger clubbing. Bronchoscopic examination revealed a normal bronchial tree apart from the continuous escape of clear mucus from the bronchus to the apex of the right lower lobe. At operation the right lower lobe felt like a carneous mass,

while freeing the lobe from the chest wall to which it was adherent this mass was torn into and resembled friable placental tissue. The medial segment of the middle lobe was also found to be replaced by the same fleshy tissue. Only a lower lobectomy was performed as the diagnosis of pulmonary adenomatosis was not suspected and as it was thought to be an unusual type of tuberculous infection. Examination of the lobe revealed many areas of variable size showing greyish white consolidation due to pulmonary adenomatosis. She had a stormy convalescence and developed bilateral deep vein thrombosis of her legs. After ten weeks convalescence she was well enough to be discharged home. When she reported three weeks later she was obviously unwell. X-ray examination now showed many areas of opacity in the right upper lobe and a similar appearance was seen in the lower two thirds of the left lung - in addition the left lower lobe showed patchy consolidation. She died at home three months later.

Historical.

Within recent years pulmonary adenomatosis has come into ever increasing prominence. In this condition the alveoli are lined by tall columnar cells which secrete mucous which may be scanty or abundant. In different

cases the cells themselves will range from regularity in size, shape and smallness of nuclei to complete irregularity in size, shape and nuclei. Cases with the regular type of cell have been described as pulmonary adenomatosis whereas the cases showing gross cell irregularity have been called alveolar cell carcinomata of lung.

The first mention of this condition was made by Malassez in 1876 when he described the first case of alveolar cell carcinoma of the localised nodular type. Musser in 1903 recorded the first case of diffuse type of alveolar cell carcinoma in which both lungs were involved over widespread areas by confluent tumour. In 1907 Helly reported a case which he described as pulmonary adenomatosis.

The etiology and pathogenesis of pulmonary adenomatosis is discussed in the joint article published in the British Journal of Surgery (1953) by Hutchison and myself, a reprint of which is included at the end of the thesis.

Gross Pathology.

It has been customary to speak of two types of alveolar cell tumour - the multiple nodular type and the diffuse. It would seem, however, that there is

considerable justification for agreeing with Good et al (1950) who suggest that the one is merely an early stage of the other, the diffuse type appearing when the multiple nodules have become so multiplied and numerous that they become confluent. In the case of Alexander and Foo Chu (1947) the right lung was the seat of diffuse alveolar cell tumour while the left lung had one solitary nodule in the lower lobe.

The area of lung involved, be it a segment or an entire lobe, is solid and heavier than normal. If the diagnosis of alveolar cell tumour has not been entertained before operation or post mortem the appearances may be diagnosed as the hepatisation stage of pneumonia and only when the tissue is seen under the microscope is the correct diagnosis appreciated. This happened in the cases of Bonne (1939) and Hoyle and Dacie (1943). In Case No. 47 (page 710) the correct diagnosis was not in mind and the pinkish grey round nodules seen in the pleural surface of the specimen reminded one of placental tissue.

Fig. No.152 (page 720) shows part of the external aspect of the lobe; while several adhesions can be seen these give no true indication of their density at several areas notably to the diaphragm; the freeing of the

adhesions on this aspect caused tearing of the lobe. Some cases have no pleural adhesions. Fig. No. 152, (page 720) clearly shows the intact state of the pleura, the nodules of tumour tissue seem to bulge out from the lung and push the pleura before them. Fig. No. 153, (page 721) shows the cut surface of the specimen. The lobulated nature of the growth is striking. In the inferior aspect of the lobe the tumour nodules have coalesced, in the superior and peripheral aspect, however, the tumour nodules are well seen and vary in size from some about 1 cm. in diameter through infinite gradations to others so small as to be scarcely discernible by the unaided eye.

If untreated the tumour gradually extends through the remainder of one lung and across into the other. This spread of growth is inevitable. Case No. 47, (page 710) had at least two lobes invaded at the time of operation; by the time she died all lobes were involved. Good et al (1949) found more than one lobe involved in 6 out of their 12 cases; in 5 of these the disease was bilateral. There were 6 surgical specimens; in one of these a nodule developed in the opposite lung seven months after operation. Of the 14 cases not included in the series reported by Swan (1949) 9 were

bilateral and 5 were unilateral.

Neubuerger and Geever (1942) in a review of the cases up to 1942, found that 50% of the cases had metastases, 25% of these were in hilar and bronchial lymph nodes but 25% had distant metastases. Swan (1949) in a review of cases since 1942 found that 15 out of the 27 had metastases. Of the cases reported in sufficient detail by Paul and Ritchie (1946) (not included by Swan), Laipply and Fisher (1949) and McCallum (1949), 4 out of 14 had metastases, 3 of which included distant metastases, 2 had involvement of cervical glands, 1 had spread to the adrenal and 1 in addition had a paraplegia. Of the 12 cases reported by Good et al (1950) only 2 had metastases, 1 being to the liver and adrenal. This great decrease in metastases is explained by the authors' awareness of the disease and also because they operated on any lung shadow, the diagnosis of which could not be made by clinical or ancillary measures. In 114 cases they were rewarded with 65% of carcinoma resection.

Pathological Histology.

Fig. No. 155 (page 722) shows the histological appearances seen in the upper and peripheral areas of

the lobe. Here the essentially nodular character of the growth is well shown. Small nodules of tumour lie among lung alveoli which are little altered. Figs. No. 154 and 156 (page 722 and 723) are illustrations taken from the more solid basal portion of the lobe; here the alveolar pattern is largely lost but the interlobar septa are still preserved and the pleura remains uninvaded. The striking feature of the tumour is its papillary structure. The tumour cells are cubical or low columnar and are regular in arrangement. They are in a single layer, non-ciliated and some are mucin secreting. The cells are regular in size. The nuclei lie centrally and no mitotic figures are seen.

Although no cilia were seen in Case No.47 (page710) cilia do occur in pulmonary adenomatosis. In many cases there is the formation of mucin both within the cell and also in what remains of the alveolar spaces. Mucin production may be abundant and may spill from one alveolus to another and eventually reach alveoli as yet unlined by tumour tissue. If mucin secretion is a feature, droplets of basophilic secretion are seen near the free margin and are positive with mucicarmine stain and P.A.S. reagents. The alveolar walls are regular, contain capillaries and elastic tissue and are intact.

Indeed, Good et al (1949) believe it essential for the unequivocal diagnosis of alveolar cell tumour that the alveolar septa be normal or only slightly thickened, if at all, and show little evidence of inflammation. A few cases, notably that of Hoyle & Dacie (1943) have shown invasion of the pleura by carcinomatous tumour tissue. As in many malignant tumours the histological picture varies from case to case and in different areas of the same tumour. Good et al (1949) have graded their cases according to the conventions of Broder and suggest that Grade 1 and 2 correspond to pulmonary adenomatosis and 3 and 4 to alveolar cell carcinoma. All their cases in Grade 1 and 2 were surgical, but 4 out of 6 in Grades 3 and 4 came to autopsy, two of these were in Grade 4 and both had distant metastases. One of the cases of Laipply & Fisher (1949) showed mainly adenomatosis with focal invasion of cancer in one lobe. Paul & Ritchie (1946) report four cases in which some areas showed pulmonary adenomatosis and others showed squamous cell carcinoma.

Frequency.

Neubuerger & Geever (1942) reviewed 25 cases of alveolar cell tumour including two of their own autopsy

cases. Swan (1949) found 26 cases in the literature published since 1942 and added a further case (which had been omitted by Neubuerger & Geever) in addition to 9 cases of his own, bringing the total to 61. Swan appears to have omitted 5 cases by Paul & Kitchie (1946). Drymalski et al (1948) reported 3 cases, Jennings (1948) 2 cases, Laipply & Fisher (1949) 2 cases, McCallum (1949) one case, and Good et al (1950) added 12 cases from the Mayo Clinic.

The total now stands at 88 cases with the publication of 2 further examples by Kent. Undoubtedly the number of cases is greater than 88, for investigation of those reported frequently reveals that they were originally classed as bronchial carcinoma of unusual type. It is therefore reasonable to assume that other examples are filed under the heading of adeno-carcinoma of lung.

The incidence of these tumours is difficult to assess as many large hospitals have never recorded a case. Swan (1949) "screened" 900 pulmonary neoplasms at the Army Institute of Pathology and found 9 cases. Neubuerger & Geever put the figure at no more than 5% of new growths of lung. Prior to 1943 only 3 of the reported cases had been treated surgically, but with wider recognition of the condition and in recent years

with the more active measures used in the treatment of doubtful lung shadows increasing numbers are being reported; as many as 8 cases have been treated surgically at the Mayo Clinic (Good et al, 1950). Seven of these cases occurred in a series of 275 resections of lung for neoplasm.

Sex and Age Incidence.

Neubuerger & Geever (1942) and Kent (1951) give the sex incidence as 1:1. Good et al (1950) found the incidence in their 12 cases to be 7 females to 5 males, and Swan (1949) found a similar incidence. This makes an interesting comparison with bronchial carcinoma in which males predominate in different series in a proportion varying from 3:1 to 10:1 and corresponds more to the sex relationship found in bronchial adenoma. The age incidence is between 40 - 70, although the youngest reported case according to Kent (1951) was 17 and the oldest was 89. Paul & Kitchie (1946) had a case aged 76, while Taft & Nickerson (1944) had one of 79. The patient in my series of cases was 36.

Clinical Picture.

My patient had been ill for six months prior to admission to the thoracic unit. In other cases the

duration of symptoms has varied from 6 months to 2 years, though from reading the account of the case reported by Alexander & Foo Chu (1947) it would seem that the history might have extended over five years with latterly two attacks of pneumonia a year apart, the second attack being terminal. One or more attacks of pneumonia or patchy pneumonia are a frequent occurrence during the course of the disease.

In many of the cases, though not in all, the most striking feature is the abundant clear sputum produced, the reason for which is obvious when the histology is examined for a tremendous amount of mucin is produced by the cells lining the alveoli. Haemoptysis is not characteristic but does occur in about one third of the cases. It was absent in Case No. 47 (page 710).

On examination one may find patchy consolidation localised to one lobe or lung, complete lobe consolidation or physical signs consistent with bilateral broncho-pneumonia.

X-ray examination in the early case will show patchy areas of consolidation seen as small poorly defined shadows. Later with increase in extent the appearance becomes one of pneumonitis or of atypical pneumonia. More and more of a lobe becomes involved

as the disease progresses; this is followed by other centres in the adjacent lobe or in the other lung.

In Case No. 47 (page 712) the bronchoscopist saw mucoid fluid pouring continuously from the bronchus to the apex of the lower lobe but frequently bronchoscopic examination shows no abnormality, which is not surprising in view of the tumour being alveolar in site. Good et al (1949) had ten bronchoscopies in twelve cases, in only three of these was there any abnormality and none showed ulceration.

Despite the absence of positive findings by bronchoscopy it is a very valuable procedure, not only does it tend to rule out carcinoma but it provides an opportunity for cytological examination of the bronchial secretion. Good et al (1950) had six of their cases examined for sputum cytology in four the examination was positive; in one of the four the diagnosis was made from fluid obtained at bronchoscopy. All four were diagnosed as containing cancer cells, two of these were thought to be of alveolar-cell type.

Reviewing the histology at a later date they felt that a fifth case could have been diagnosed from the sputum. In expert hands this is obviously a very valuable ancillary investigation.

Because many of these cases have occurred between 40 - 60 years of age it is not surprising that they have been diagnosed as primary carcinoma of lung when the X-ray examination reveals a single area of opacity, and secondary carcinoma when the opacities are numerous and diffuse. In others indefinite pneumonitis has frequently been diagnosed. In Case No. 47 (page 710) the complete opacity of the lower lobe and the abundant sputum suggested the presence of some kind of mildly infected cyst but the diagnosis was in doubt. Good et al (1950) made a pre-operative correct diagnosis in 2 cases, while Paul & Ritchie (1946) diagnosed one. McCallum (1949) in his case arrived at the correct diagnosis having recently read a paper on the subject; it is in this "awareness" of the condition that rests the only possibility of correctly diagnosing pulmonary adenomatosis.

Treatment.

The only effective treatment is surgical resection of the affected lung and this demands that the case be diagnosed sufficiently early to enable one to resect all lung tissue seen to be involved; the prognosis by then is by no means hopeless. Since the more malignant

cases or those seen only late are usually bilateral and therefore not amenable to surgery, success in treatment demands early resection and this is possible only in those of less malignant type and therefore more likely to be free of hilar secondaries.

Of twelve cases reported in the literature treated surgically, four by pneumonectomy and eight by lobectomy, three of the latter were alive and well from six months to two years; one could not be traced, one developed a spread to the opposite lung and three died from five days to two years after the operation. One pneumonectomy is alive and well and one developed a recurrence in the opposite lung; two died, one after six months wihout evidence of recurrence. As one would expect from the inadequate resection of tissue carried out in Case No. 47 (page 710), the disease progressed and she died six months after her operation.

The Etiology of Cancer of the Lung.

The explanation for the great increase in recent years in the incidence of cancer of the lung has caused much discussion and speculation. In the early years of this century primary neoplasms of the lung were among the rarest forms of carcinoma.

This increase is exemplified in the post-mortem figures for primary malignant disease (excluding Hodgkin, myelomatosis and leukaemia but including reticulo-sarcoma and lympho-sarcoma) at the Western Infirmary, Glasgow. The average percentage of primary carcinoma of lung for the five year period up to and including 1926 was 8.7% (stomach 23.4%) and for the five year period up to and including 1949 was 24.3% (stomach 15.1%).

Ariel et al (1950) found in Illinois that whereas in 1931 the percentage of cancer of the lung to all other cancers was 2.1%, in 1946 the percentage had risen steeply to 11.7%, yet cancer of the stomach had remained constant at 5.5%. In England and Wales, Doll & Hill (1950) found the death rate from this disease in 1922 had increased fifteen times by 1947; they also noted an increase of the disease in Switzerland, Denmark, Canada and Australia.

Undoubtedly, as Smithers (1953) has pointed out, in some measure the increase is accounted for by improved methods of diagnosis, including improved radiology and bronchoscopy, and by a better understanding of the pathology of hilar lung tumours which present rather as mediastinal growths than pulmonary ones - the condition formerly referred to as mediastinal sarcoma or oat-cell tumour which was in fact mediastinal secondary involvement of lymph glands from a primary oat-cell or spindle-cell bronchial carcinoma. The increase may also be explained in part by the fact that there is a much larger group of old people living today who because of their age are more likely to develop cancer. But the increase has been so enormous that these factors in themselves cannot alone be held responsible.

Two main causes have been suggested for this increase -

(1) a general atmospheric pollution from domestic smoke, the exhaust fumes of motor cars, dust thrown up from tarred roads, etc. and

(2) the smoking of tobacco.

From both of these the inhalation of carcinogenic agents is implied. Proof of this is difficult and the proof must of necessity be pieced together over a period of several decades and not in a matter of a few

years. If carcinogenic agencies are at work one must believe with Cramer (1938) that "all carcinogenic agents have this in common: that they induce cancer only after a lapse of time occupying a considerable fraction of the normal span of life; and, furthermore, that this period of induction is much more prolonged with a weak carcinogenic agent than with a very active one". He continues "cancer does not appear as a bolt from the blue in a healthy tissue, but that as a result of this prolonged action of a carcinogenic agent the tissue or organ on which it acts undergoes pathological changes before cancer develops".

Unfortunately, in this series of 55 cases there are insufficient data on which to found any decision as to the etiological factors at work, many of the cases date back to earlier years when the influence of smoking on the etiology had not been thought of; in consequence, no attempt had been made to take account of that aspect of their history.

Apart from those occupations in which there is clear statistical evidence of some increased liability to lung cancer the figures put forward in support certainly suggest very strongly that smoking has a definite carcinogenic influence (Wynder & Graham, 1950; Doll & Hill, 1950; Dungal, 1950).

The whole problem of the incidence and etiology of carcinoma of the lung in relation to occupational risks and to the possible influence of smoking has been fully and ably reviewed by Doll (1953) in the Milroy Lectures and it is unnecessary to recapitulate his arguments and statistics here. It is no doubt significant that the great tobacco companies have been unable seriously to dispute the conclusions reached that cigarette smoke is in some way, as yet not clearly defined, associated with the increased incidence of lung cancer.

One must, however, report that the association between the increased incidence of cancer of the lung and smoking has not always been found a significant feature in large series of published cases (Ariel et al 1950; Ochsner et al 1947; Fried 1948).

No mention of the effect of smoking and smoke would be complete without reference to the work of Stocks (1947 & 1952) who stated that the risk of dying from lung cancer in any area is closely related to the number of domestic chimneys in that area. He points out that the areas of Shoreditch, Bethnal Green, Finsbury and Stepney are the sites of highest lung cancer mortality and believes that this is due to

the fact that these areas lie in the path over which the prevailing wind sweeps the smoke from London's congested centre. Evidence pointing in the same direction has been drawn by Taylor & Waterhouse (1950).

Carcinoma and Tuberculosis.

In this series of cases no association between tuberculosis and carcinoma of the lung was found, in none of the 55 specimens was there any evidence of active tuberculosis. It must be remembered, however, that the prime object in these 55 specimens was to obtain as accurate as possible localisation of the tumour and no attempt to search by serial sections for evidence of minimal tuberculous lesions was made. To have done this would have spoilt the main purpose of the specimens.

Carcinoma and Pneumoconiosis.

Silicosis while usually complicated by tuberculosis does, in a proportion of cases, bring about the development of bronchogenic carcinoma. In this series there was one bronchogenic carcinoma in a stone mason (Case No. 48 page 725) and one in a man whose occupation as a pipe coverer laid him open to asbestosis (Case No. 49 page 735) but neither showed evidence of pneumoconiosis per se.

Occupation.

No particular occupational proneness was apparent in this series; there were four miners and five engineers, four of whom were likely to be working in oily surroundings. The inhalation of dust was an occupational hazard in 12 cases: the four miners previously mentioned, two riveters, two drillers, one stone mason and three other workers. Wiklund (1951) found no relationship between dust inhalation and carcinoma of the bronchus. On the other hand, in those cases in which the occupation was stated 9 or 16% had been accustomed to office work. There were two doctors and one dentist in the series.

Age and Sex.

The average age of the 55 cases was 50 years. The youngest was 37 and the oldest was 65. It must be remembered that these were cases which were successfully resected and hence the average age of all patients with cancer of the lung would probably be considerably below 50. If the rapidly growing undifferentiated and oat-cell tumour cases which were denied operation were included they would bring in a considerable number of cases into the younger age groups and thus the average age would be considerably reduced.

II Table to show Age Incidence of Lung Cancers successfully resected.

Age Group	30-39	40-49	50-59	60-65	Total
No. of Cases	5	20	27	3	55

There was for a time a tendency to turn down as unsuitable for operation patients in their 20's or early 30's, particularly as these cases usually had an oat-celled tumour. In the same way patients over 60 were assessed with additional circumspection and were subjected to operation only if they were in particularly good condition.

Sex Incidence.

There were 51 males and 4 females, an incidence of rather more than 12:1, similar to that of Price Thomas (1951). The post-mortem figures at the Western Infirmary, Glasgow for the years 1922 to 1948 inclusive show a preponderance of males over females of just under 3:1 (the figures are 187:64). Brooks et al (1951) found the sex incidence in 306 confirmed cases to be 9:1, a figure conforming closely to that of Mason (1949).

Pathology of 55 Resected Cases.

The following paragraphs deal only with lung carcinomata which it had been possible to resect, and this mode of selection undoubtedly influences the numerical distribution in the various sites. The right lung was responsible for 29 and the left lung for 26. This conforms to the incidence reported by many writers. Ochsner et al (1947) found the right more often involved than other writers, the incidence being 76:53. Halpert (1940) found the incidence 49 in the right lung and 38 in the left; while Mason (1949) found the discrepancy even less - 52.3% in the right lung. Willis (1948) found 45 in the right lung and 36 in the left. It is generally agreed that the predominance of right-sided tumours over left-sided ones is due to the larger surface of the right lung (Ochsner et al, 1947).

In many specimens it was not possible to define the exact origin but in those in which this was possible it was found that the apical bronchus was the site of origin on the left side in 2 and on the right in 3. In the lower lobes the apical segment was involved in 5 instances on each side. On the right side, out of 20 tumours in the lower lobe, the posterior division was involved in 4 instances. The lingula was the site of origin in 2.

Table No.III to show the Distribution of Tumours in the various lung lobes.

	Left Lung	Right Lung	Total
Upper lobe	14	8	22
Lower lobe	9	20	29
Right middle lobe		1	1
Stem	3		3
Total	26	29	55

My figures are too small to be statistically significant although the difference between upper and lower lobe corresponds closely to the 58% for lower and the 42% for upper reported by Borrie (1952). He found the left lower lobe predominated over the right by 61:55; his figures in the upper lobes were 55 left and 26 right.

No doubt this preponderance of the left upper lobe over the right is explained, in part at least, in the extra length that the left stem bronchus possesses before giving origin to the upper lobe bronchus thus making possible resection of left upper lobe tumours encroaching on the stem bronchus more feasible. A tumour seen projecting into the right stem bronchus from its upper lobe branch is unlikely to prove resectable

and may even be turned down at bronchoscopy; on the left side, however, the hope of resection is still a real possibility as sufficient length of left main bronchus may well be free of tumour to allow of pneumonectomy.

In regard to the specimens themselves:- After removal they were preserved as soon as possible and were generally placed in 10% formalin within two to three hours. The specimen was first washed with saline and all mucus and blood was cleared out of the bronchus. Because of the difficulty in maintaining the shape of the lung in specimens which I personally preserved, it was my custom to inject the bronchial tree and the main vessels with the preservative and then to tie off the respective structures while distension was maintained. The lung was pinned out on cork, covered over with cotton wool and immersed in a basin containing the preservative. While this method of pinning the specimen to a flat surface did nothing to retain the shape of the specimen it at least had the merit of making most of the specimens roughly comparable in shape. The specimen was allowed to harden properly for 7-10 days before being cut. I found if the specimen was cut in less than 7 days the

difficulty of maintaining its shape was increased and as the knife went through the lung the tissue tended to turn over and follow the knife thus causing a "skidding" cut instead of a clean one. To overcome this difficulty I cut the specimen from Case No. 50, (page 741) with a meat slicing machine. In this way I had hoped to be able to see the exact point of origin of the tumour from the bronchus and to trace the outward spread of the tumour. As can be seen from Fig. No. 167, (page 747) this was quite a suitable method of displaying the site of the tumour, in this case in one slice the tumour can be seen arising from and blocking the bronchus to the apex of the lower lobe; several slices deeper the tumour tissue is seen to surround the bronchus to the whole lower lobe, Fig. No. 168 (page 748). While this was a satisfactory method it was obvious that this was going to prove too unwieldly for my purposes and I reverted to cutting the specimens with the large knife. The first cut was taken through the periphery of the tumour or the pneumonic process if such was present. This gave some indication of the character of the specimen and where the next cuts should be made. Longtitudinal cuts were made in order to maintain the specimen as whole as possible and where it was to best

advantage the cut was continued along the length of the affected bronchus. In order to show the tumour better the bronchus edges in its vicinity were trimmed where necessary. To obtain a good record of each specimen the number of cuts made in each was limited. Few angled or vertical cuts were used. It was found that if the final size of the specimen was reduced by multiple cuts subsequent difficulty in its orientation occurred. Once a satisfactory cut was made through the tumour further fixation was carried out by replacing the specimen for several days in fresh preservative fluid. Light cotton wool packing was used to preserve the shape if there was a cavity in the tumour, an abscess cavity or if the bronchus lumen was related to the specimen. The portion of specimen which faced the one that was being retained was used for histological blocks. A rough drawing was made of the original to include bronchus, tumour glands and vessels (if visible) and the cut facing it was used as a mirror image from which the blocks were taken and planned out on the drawing.

In the actual specimens several features were striking. It was quite astonishing to see to what size some of the tumours had reached. Eighteen of the fifty five specimens were more than 5 cm. in

diameter, while fifteen were more than 6 cm. The largest tumour of all occurred in Case No. 51, (page 762) (one of the hypertrophic pulmonary osteo-arthropathy cases), this tumour reached the truly gigantic proportions of 12 x 7.5 cm. The tumour in Case No. 52 (page 770) was 10 cm. in diameter and in Case No. 53 (page 778) 8.5 x 9 cm.

The shape of the specimens was diverse, some were cannon ball in appearance both on X-ray and as a specimen, a feature further illustrated by Case Nos. 51 and 52 (page 762, 770) neither of which was a secondary tumour. Some tumours seemed to erupt into the main bronchus and thence to seek the line of least resistance and continue to grow as a polyp up the bronchus. Case No. 54 (page 784) presented a polyp within and blocking the stem bronchus, 2.5 cm. high and 1 cm. in width. Fig. No. 183 (page 784) shows the polypoidal tumour projection, while Fig. No. 184 (page 785) shows the polypoidal process turned forward to show the bronchus that had been completely occluded. This blockage produced a quite striking bronchiectasis of the lower lobe. Case No. 55 (page 793) produced a specimen which was dumb-bell shaped, partly intra-pulmonary and partly intrabronchial; the largest

portion of the dumb-bell being in the lung substance. The tumour appeared to have burst through the wall of the bronchus and to have spread in a proximal and distal direction to an extent of 2.5 cm. and to an elevation of 1.5 cm. The direct invasion of the bronchial wall in a proximal direction is here well seen as is the resistance of its cartilaginous element to the last. The tumour has insinuated itself beneath the mucosa and the peri-bronchial fascia, elevating and finally invading both; a rampart of cartilage, however, can still be seen to resist the tumour's advance.

A different type of polypoidal growth is to be seen in the specimen from Case No. 56 (page 803). Here the polyp stands up within its own necrotic tumour (if such is possible). To produce this rather unusual appearance the tumour centre has become necrotic and no doubt at the time of the patient's haemoptysis he coughed up the necrotic tissue, thus leaving a thin rind of tumour wall $\frac{1}{4}$ x $\frac{1}{2}$ cm. thick and a central polyp. The latter measured $2\frac{3}{4}$ cm. high and $1\frac{1}{2}$ cm. in width and was attached at is base to the tumour wall (Fig. No.190, page 803). A study of X-rays in this case shows how easily this tumour could have been mistaken for a lung abscess.

While the most striking feature presented in many of the tumours was the large rounded or oval tumour mass, in others it was a tendency to polypoidal growth within a large bronchus, there were some in which the outstanding feature was submucosal spread. This occurred in Case Nos. 57, 58, 59, 60, 61 and 62, (page 814, 824, 831, 840, 849, 857) and was most striking in Case Nos. 58, 59 and 61, (page 824, 831, 849). In some of these it would seem that the resistance of the bronchus to invasion was such as to cause the tumour to grow proximally and distally alongside it instead of invading it. This is well seen in Case Nos.59 and 60 (page 831, 840). It is surprising that a carcinoma under certain conditions should show such respect for the bronchial wall, one would expect that if the cartilaginous rings are the reason for the tumour being prevented from entering the bronchus that the tumour would at least invade between these rings as quite frequently happens in the much more slowly growing adenoma. One wondered if the type of tumour might hold the explanation for this group of tumours which show apparently more respect for the bronchus than do some of the others. No such difference was found for both epidermoid and undifferentiated

histological categories were represented. There were, in fact, three epidermoids (Case Nos. 55, 57 and 58 page 794,817, 825) and five undifferentiated, including four oat-cell tumours (Case Nos. 59, 60, 61 and 62 page 832, 841, 850, 860).

Ten of the tumours showed central degeneration varying from quite small spaces to cavities several centimetres in size (Case No. 63 page 867). The 10 cases are Case Nos. 51, 56, 62, 63, 64, 65, 66, 67, 68 and 69, (page 762, 803, 858, 867, 875, 881, 888, 896, 904, 912). The importance of bearing in mind that X-ray appearances of lung abscess in a middle-aged patient are not necessarily due to an abscess and commonly are ultimately found to be tumours, is discussed and stressed under differential diagnosis. The value of this warning is clearly evinced in Case Nos.56 and 63 (page 803, 867). In both, because the rind of tumour tissue is so thin, a mistaken diagnosis of abscess could have been made.

In the same way a true lung abscess may be mistakenly diagnosed as the primary cause of illness in a middle-aged or elderly patient when, in fact, the abscess is simply a manifestation of graver import, namely a carcinoma proximally placed in the bronchus. In consequence,

appearances resembling lung abscess in such a patient should inevitably and immediately raise the suspicion of carcinoma in the clinician's mind. The importance of this statment is amply borne out by a study of Case Nos. 57, 68, 70 and 71 (page 805, 898, 914, 923), all of whom had a lung abscess distal to a carcinoma; a particularly good example is Case No. 57 (page 805). I was asked to see this case in the medical wards of a teaching hospital where he had been diagnosed as a chronic lung abscess. Aware of the possibility of an underlying carcinoma of lung, I suggested bronchoscopy. An epidermoid carcinoma was found in the lower lobe bronchus.

Nine specimens (16.3%) showed distinct evidence of pneumonic change distal to the tumour. The best examples of these changes occurred in Case Nos. 72 and 73 (page 930, 936). Once again in this age group of patient the danger of misdiagnosing carcinoma as pneumonia must be underlined. Pneumonia of considerable extent was present in these 16.3% of lungs removed for carcinoma; it follows therefore that the finding of a consolidated lobe or part of a lobe on clinical examination of the middle-aged patient is not always due to an uncomplicated pneumonia. The previously

mentioned Case No. 72 (page 930) had pneumonia on three and possibly four occasions within three months. Had the suspicion of carcinoma been entertained immediately the second attack occurred some ten weeks would have been saved and a patient with an oat-cell tumour might have been diagnosed and operated on at 7 or 8 weeks instead of at 12 weeks. If this had been the course of events she might not have died six months after operation and still be alive and well today. Four weeks lost before treatment of an oat-cell tumour must diminish the chances of successful operation and subsequent survival. I mention this to stress the fact that even the best physicians do not always appreciate the great significance that such a case history of a laggard or recurring pneumonia may be the ghost shadow of carcinoma.

Marked examples of bronchiectasis distal to the tumour occurred in 6 specimens (11%),(Case Nos. 54, 55, 71, 74, 75 and 76, page 784, 793, 928, 951, 961, 970). Two of these specimens (Case Nos. 74 & 76 page 951, 970) showed it in addition to pneumonic changes. The specimen from Case No. 54 (page 784) is the best example. The lower lobe is blocked by carcinoma and this has produced tubular bronchiectasis

of the distal extent of the lower lobe bronchi.

In four specimens lymph node invasion was suggested by the macroscopic appearances but disproved on histological examination; they were not, in fact, invaded.

Markedly invaded glands are obvious when felt in situ and when cut across. A difficult problem is, however, presented by glands in which invasion is suspected but is doubtful. Frequently one has felt at operation glands with the features of invasion which when cut across later show greyish-white areas resembling neoplasm in their greenish-black texture and yet when examined histologically they show no tumour cells. The reversal of this state of affairs also occurs, but one's impression is that glands only doubtfully invaded on gross examination are less often found to be invaded than are normal-looking ones.

While the majority of the specimens show relationship to a stem or subsidiary bronchus a few are definitely of peripheral type, a typical example being Case No. 77 (page 979). In this specimen the tumour lies in the posterior division of the upper lobe bronchus; no connection with a bronchus could be demonstrated.

Other features of interest in the specimens include the mechanism causing distortion of the main or of the subsidiary carina. In Case No. 78 (page 987) the tumour pushes upwards between the anterior and middle divisions of the lower lobe bronchi and in so doing it displaces and broadens the carina between the two divisions. The specimen from Case No. 79, (page 994) shows an invaded gland to be considerably enlarged and to be pushing the carina between the middle and anterior divisions upwards. It has caused the origin of the anterior bronchial division to take a more horizontal course than normal. The specimen in Case No. 80, (Fig. 281 page 1006) on one cut surface shows a tumour in the vicinity of the stem bronchus to the apex of the lower lobe and in the next cut the tumour is seen to arise from this bronchus having blocked it entirely up to but just short of the stem bronchus. Case No. 48, (page 732) illustrates how the tumour may tightly encircle and on occasions invade the major pulmonary vessels. In this instance the tumour tightly encircles and partly occludes the stem pulmonary artery which can be seen as a slit immediately above the main bronchus. Naturally this encirclement of the pulmonary artery is of much less importance to prognosis than encirclement

of one of the pulmonary veins for any tumour emboli released before or during the operation will be trapped in the pulmonary bed of the lung removed.

Considerable assistance in diagnosis and assessment of future cases is to be found in comparing many of the specimens with the appropriate X-ray. The lateral X-ray film in Case No. 81 (page 1012) reproduces very accurately the appearance of the specimen. In it the tumour can be seen arching over the stem bronchus and extending upwards into the apex of the lung just as is apparent in the specimen. Further the inverted D-shaped invaded gland above and to the right of the stem bronchus and above the upper lobe bronchus can also be visualised on the X-ray.

In Case No. 82 (page 1023) the approach to and the relationship of the lower lobe bronchus to the bulk of tumour is well seen in the lateral X-ray film as a narrow more translucent "corridor" which reaches the tumour just below its mid-point. The lateral X-ray film in Case No. 59 (page 830) shows the dense tumour shadow with immediately below a rather rounded less dense area with the bronchial "markings" diverging downwards from it - this lesser shadow probably corresponds to the invaded gland seen between the

middle and lower lobe bronchi on the specimen.

The lateral film of Case No. 67 (Fig. 230, page 895) shows a mirror reflection of the specimen whose lobulation on its anterior aspect is well reproduced even to the toe-like projection at its lower anterior end.

In Case No. 56 (Fig. 189 page 802) the lateral X-ray film shows the tumour cavity and its contained polypoidal growth lying just above and in front of the main bronchus which is seen end on as a clear circle of air. The postero-anterior films also show the cavitation but fail to reveal the polyp.

In Case No. 63 (Fig.218 page 867) the tumour specimen quite accurately reproduces the appearances on the postero-anterior film. The bulk of the tumour is seen on the medial and superior aspect of the tumour cavity whilst pneumonic and bronchiectatic changes are visible on the inferior aspect.

Blockage by tumour of the anterior segment of the upper lobe is seen in Case No. 83 (Fig.291 page 1033). On the anterior x-ray film the tumour is seen as a lateral placed shadow towards the middle and lower aspect of the upper lobe; this area of lung is devoid of lipiodol because the anterior segment of the bronchus

is blocked as the specimen shows. The lingular bronchus is partly occluded by downward pressure of the tumour. In the lateral X-ray film lipiodol filling occurs in only part of the anterior segment, in none of the posterior and only faintly in the lingula.

Fig. 174 (page 761) shows the specimen from Case No. 51. In it the massive peripheral type of tumour is seen lying in the apex of the lower lobe centred on the bronchus to the apex of the lower lobe. No connection could be demonstrated between the bronchus and the tumour. As is usual the origin of the middle lobe bronchus can be seen directly opposite the bronchus to the apex of the lower lobe. When comparison is made between the specimen and the postero-anterior X-ray it is surprising to see just how far laterally the shadow may extend in a tumour within the apex of the lower lobe. The lateral X-ray film shows the true extent of lower lobe involvement, and reveals that quite a large part of the lower lobe is still uninvolved (Fig.170 page 758). The X-rays in spite of the difference in hardness of the films reveal quite a considerable increase in size in the space of twenty-five days even for an undifferentiated epidermoid growth. Case No. 61 (specimen fig. 209

page 849 and X-ray Figs. 207 page 847) reveals the position normally seen in a tumour of the bronchus to the apex of the lower lobe - namely close to the hilum in the postero-anterior view and completely posterior and at quite a high level in the lateral.

The specimen from Case No. 84 (page 1041) is an excellent example of a tumour blocking the stem bronchus and all its divisions. When one looks at the penetrated X-ray film (Fig. 293 page 1039) one sees that the left lung has become largely atelectatic, in consequence, the trachea is pulled over to the tumour side and the healthy right bronchus is seen to the left of the mid-line. Further study of the X-ray films shows the point of complete blockage of the stem bronchus about one and a half inches below the carina - an appearance which accurately fits with the findings on the specimen.

Case No. 80 (Fig. 278 page 1003) further illustrates the position on X-ray films of a tumour of the bronchus to the apex of the lower lobe. Further, it confirms just how adjacent to the bronchus to the apex of the lower lobe is the origin of the bronchus to the middle lobe. As can be seen, they are practically diametrically opposite - a matter of great importance in performing a

lower lobe lobectomy! It is all too easy to include the middle lobe bronchus in the bronchus clamp and having cut the bronchus to realise, too late, that one has also sacrificed the middle as well as the lower lobe. On the whole, it has not been the practice at the thoracic unit to limit resection for carcinoma to lobectomy, but such resection has its adherents at the present time.

The specimen from Case No. 77 (Fig. 270 page 979) demonstrates the presence of a peripheral tumour in the posterior segment of the right upper lobe bronchus. On the postero-anterior X-ray film it will be seen to lie in the lateral aspect of the chest and relatively low in the lung (about its mid-zone). The lateral X-ray film reproduces fairly accurately the appearances of the tumour including its rather flat postero-inferior aspect and the downward pressure of the tumour against the posterior end of the oblique fissure. The latter is seen as a downward bulge of the thin oblique white line which is the fissure.

The specimen in Case No. 72 (Fig. 250 page 935) shows a tumour in the right lower lobe bronchus which has produced pneumonia and atelectasis of the lobe distal to the tumour. The X-ray films show the

opacity in the shrunken lobe and the elevation of diaphragm which has resulted from the atelectasis.

Histological Features of Resected Carcinoma.

Willis (1948) states that most writers classify the histology of lung tumours into adenocarcinoma, squamous-celled carcinoma and undifferentiated carcinoma but he adds this warning "remember that individual tumours show various structural combinations and great pleomorphism is possible in one tumour". In attempting to fit the histology of these cases into these three categories, I found his warning very true, indeed in some instances, e.g. Case No. 83 (page 1034) I found it difficult to decide whether to classify the tumour as undifferentiated squamous-celled carcinoma or as an undifferentiated carcinoma. Because of this difficulty Willis (1948) preferred to divide his 84 cases into this more complete category:-

Adenocarcinoma (including acinar, papillary, mucoid and signet ring)	16
Squamous only	12
Combined squamous and adenocarcinoma	2
Anaplastic (oat, spindle, spheroidal and pleomorphic)	37
Combined anaplastic and adenocarcinoma	8
Combined anaplastic and squamous	5
Combined anaplastic and squamous and adenocarcinoma	5

As the material for this study by Willis (1948) was

taken from post-mortem cases it is not surprising to find that anaplastic or undifferentiated tumours alone or along with recognisably different structures occurred in 64% as against 36% for glandular alone or in combination, while squamous-celled carcinoma alone or combined occurred in only 27%.

In 51 of this series of 55 cases the histology was available for examination. As these were all instances in which the material was obtained by operative removal it is not surprising to find that many more tumours were well differentiated. The undifferentiated tumours occur less frequently in this series for two main reasons. Firstly oat-celled and undifferentiated tumours usually grow so rapidly that the case is already inoperable by the time the diagnosis is made; secondly there is a definite tendency in the thoracic unit to refuse operation in those in whom the histology of the bronchoscopic biopsy is reported as oat-cell or undifferentiated. To refuse operation in cases of this kind is probably unjustified as when their histological picture is viewed overall some will undoubtedly prove to be differentiated tumours.

Table No. IV. Histological Type of Tumour in 51 Cases.

Squamous Celled	Oat Celled	Glandular	Undifferentiated
32 or 62.7%	7 or 13.7%	8 or 15.7%	4 or 7.8%

There were 32 examples of squamous-celled carcinoma, 7 of these were undifferentiated (Case Nos. 51, 73, 76, 77, 80, 85 and 102, page 763, 942, 971, 972, 1008, 1049 and 1175). There were 7 oat-celled carcinoma (Case Nos. 48, 60, 61, 62, 65, 67 and 72 page 734, 841, 850, 860, 883, 897, 930), and 8 glandular (Case Nos. 49, 50, 52, 56, 64, 68, 82 and 86 page 740, 749, 771, 804, 869, 906, 1025, 1057). The remaining 4 were examples of undifferentiated tumours (Case Nos. 53, 59, 66 and 83 page 772, 832, 889, 1034).

Borrie (1952) in a total of 200 resected lung tumours found 68% epidermoid, 27.5% undifferentiated and 4.5% adenocarcinoma. The comparative figures in this series were 62.7% epidermoid, 21.5% undifferentiated including oat cell and 15.7% adenocarcinoma.

In 1952 McGrath et al wrote a praiseworthy article on the possibility of bronchogenic carcinoma arising from multiple sites of origin, as occurs in tumours of the lip and skin. Their study comprised 87 specimens of bronchogenic cancer examined by the large section

method. These sections included the bulk of the tumour and as much as possible of the related bronchus and adjacent non-neoplastic tissue. They were then able to examine sections 8 x 18 cm. in size. In 13 specimens they demonstrated to their own satisfaction in what they call the bronchial mucosa "in immediate continuity with the main tumour" pre-invasive squamous cell carcinoma in general limited by an intact basement membrane. They called these areas "contiguous plaque phenomenon" and they claimed to find these as far away as 7 cm. beyond the "obvious limits of the tumour".

In 19 specimens they found what they call identical microscopic foci which lacked continuity with the main neoplasm. They believed that these were independent growth centres separated by normal mucosa from 1 to 10 cm. Some of these "independent microscopic foci" were as large as 3 cm. in length and apparently were found in bronchi both proximal and distal to the cancer and even in other lobes.

In 7 specimens they found both contiguous plaques and independent microscopic lesions; in 25 others either one or other alone was encountered while in 5 further specimens 2 "grossly visible independent tumours" were seen.

Pleomorphism within the tumour was striking; less than half of the tumours (42) revealed only one type of architecture, in 45 specimens they found 116 "different structural patterns", in many of which no possible developmental relationship could be attributed to the two or more patterns seen in a single tumour; well differentiated squamous-cell carcinoma with well differentiated adenocarcinoma, spindle-cell alveolar carcinoma with oat-cell or signet-ring carcinoma. In 27 tumours there were 2 patterns, in 16 there were 3, in 6 there were 4 or 5. Using the dissecting microscope they claimed to find a geographic distribution of each type which usually did not recur within the tumour mass. They felt that these different types seen in juxtaposition in the same tumour mass were independent tumours with different polarisation and they concluded that many bronchogenic carcinomata arise from several proximate sites.

It is perhaps presumption on my part as a surgeon to criticise a pathological paper particularly one with such an extensive histological study but there are several points of criticism which seem worthy of mention.

It does not seem completely clear that serial

sections were carried out in all these examinations; if they were not, it is just possible that some of the so-called "contiguous plaque phenomena" were, in fact, the outward limit of the primary tumour missed on previous sections examined. Secondly it is permissible pathologically to call these "plaques" pre-invasive squamous-cell carcinoma, and the term carcinoma is permissible when the basement membrane is still intact provided there is a noteworthy degree of loss of polarity of cells and aberration of cell type as in the intraduct carcinoma of breast described by Muir (1929). Further some of the microphotographs shown as illustrations of this aspect look to me more in the nature of gross squamous metaplasia in bronchial epithelium than of true cancer.

If serial sections were not carried out in the 19 specimens in which they found identical independent microscopic foci, doubt must arise as to their "independence" although a maximum distance of 10 cm. between the two tumour sites is difficult to explain away, nevertheless the path and course followed by these tumours within, around or between bronchi is very fickle and while a tumour at one point of section may look quite small a deeper section of lung may

reveal a massive tumour, as is well seen in Case No. 87 (page 1064).

It is notoriously difficult to maintain the normal framework, position and relationship of structures in a preserved lung even if the lung is injected with the preservative, the specimen always tends to shrink unequally at different sites in spite of all one's efforts to prevent this. Because of these difficulties is it not possible that a tumour might be sectioned tangentially and in such a way as to cut across the large tumour mass at one point, to have normal intervening lung and again to hit the tumour at some distance?

In regard to the high proportion (over 50%) of cases in which they found two or more tumour histological patterns in proximity within the main tumour mass, it has always been well recognised that this occurs in different areas of most bronchogenic carcinomata. Indeed 36 out of 84 cases reviewed by Willis (1948) definitely come into this combination of different histological patterns in one tumour, while several other of his cases could probably be included.

I find it difficult to believe that so many tumours (more than half) should be not one but two or three tumours all growing in the same area of lung and all,

as it were, fused into one. If one were to believe that columnar cells, basal cells and mucous gland cells of respiratory epithelium were all capable of producing a characteristic and individual tumour there might be some foundation for belief in this possibility, but the view that all these cells may produce a bronchogenic carcinoma of specific type would appear to have been discarded long ago.

If one believed that bronchogenic carcinoma developed from the basal cells only as did Edwards (1946) and Halpert & Pearsons (quoted by Willis 1948), it would be possible to explain some of the tumour multiplicity by the manner in which the basal cells developed their malignant growth and the type of cell which they happened to produce, for example, squamous cells and columnar cells and so squamous epithelioma and adenocarcinoma.

While the origin of the cells of bronchogenic carcinoma is surrounded by much speculation it would seem that the view expressed by Willis (1948) is the most sensible one, namely "that all of the epithelial elements in the fields of origin of the tumours, surface epithelia and glands alike, participate in their formation, just as cancer in the breast often affects

large and small ducts and acini simultaneously or successively". If one accepts this view then surely multiple patterns of different histology in the same lung the seat of malignant disease can be explained by the malignant activity of all the different cell types in the "field of origin".

Finally, it seems incongruous to me that as McGrath et al (1952) would have one believe, several quite separate malignancies should arise within a few centimetres of one another while there is at least one other lobe to say nothing of a second lung neither of which are apparently involved in this curious tendency to tumour multiplicity. If there are multiple tumours developing why are they confined to one or at the most two lobes, when there are five lobes equally open to involvement by the similar mode of onset here propounded?

Borrie (1952) in his excellent paper brought out many points of great interest in relation to the type of tumour found, the likelihood of lymph gland invasion and the dependence of survival on the type found and the presence or absence of invaded lymph nodes.

For the purposes of his paper, delivered as a Hunterian lecture to the Royal College of Surgeons, he examined 200 lung specimens and studied first the

distribution of the lymph drainage from each lung.

In the right lung he found that there were 16 sites for lymph nodes, the most constant of which was between the upper and middle lobe bronchi followed a close second in frequency by a node on the medial aspect of the right main bronchus. Less constant but frequently present were collars of lymph nodes around the upper, middle and lower bronchi with an additional collar around the apical division of the lower lobe bronchus.

In the left lung there were 17 sites for lymph nodes, the most constant site appeared to conform to that in the right lung and lay between the upper and lower lobe bronchi, this appeared to be what he termed the "lymphatic sump" of the lung. Again a collar of lymphatics was found surrounding the main bronchus, the upper lobe bronchus and at the carina between the apical and anterior segments. The lower lobe had a similar distribution to that on the right side. Both lower lobes had a wide distribution into the mediastinum along the inferior pulmonary vein and the pulmonary ligament.

Almost 50% of the 200 specimens (46% right lung and 50% left lung) had one or more nodes involved.

Borrie (1952) found as one would expect that the undifferentiated tumours had invaded lymph nodes in a

large number of specimens, in fact, 70% whereas, in epidermoid tumours only 42.5% had invaded nodes. Tumours in the lower lobes appeared to invade lymph nodes more readily than did tumours in the upper lobes, the average for both lower lobes was 59%, 75% of the right lower lobe specimens showing such invasion, not only so but invasion from lower lobes was much more widespread and would quickly reach the "lymphatic sump" area and involve the glands around the middle and upper lobe bronchi. While the left upper lobe tumours tended to show gland involvement in the lower lobe, the line of invasion in the right upper lobe tumours never extended below the middle lobe bronchus.

72 cases which had survived operation had been operated on 3 years or more previously; of these 59 had died, 50 from metastases, 31 in the first year; 70% of these were in the undifferentiated and 30% in the epidermoid group. On the other hand, 26% of the epidermoid group survived from 3 to 9 years.

He showed that 85% of the cases with lymph nodes invaded at the time of operation were dead in 3 years, 54.5% of them within one year. Only 11% (four cases) were alive, in three of which one node only was invaded and in the fourth only two. Rather unexpectedly one

reads that of those with no nodes invaded 66% were dead in 3 years, 43% of them within one year. There is therefore a difference but only a small difference between the survival time of those with invaded nodes and those without. Further the type of cell does not seem to matter if nodes are invaded, for, whereas undifferentiated tumours take their toll earlier, by the end of three years the figures for undifferentiated and epidermoid growths have largely balanced out. He was unable to find that the number of nodes invaded made any real difference in length of survival, nor did the site of the invaded node.

He rightly stresses the importance of blood spread in lung tumours, the magnitude of which is not fully appreciated. He pointed out that 20 patients dying within 15 months of operation from metastases had no lymph node invasion at the time of operation, and dissection of these specimens showed either deep penetration into the walls of the veins or actual fungation of the tumour into the vein lumen. In consequence, he concludes that blood stream invasion occurs much earlier and more easily than is generally appreciated. This would appear to underline the desirability of tying off the pulmonary veins as the

first step in the operation.

It would seem that a patient with a tumour in an upper lobe was more likely to survive. Eight out of the 13 survivors 3 years after operation had had upper lobe tumours, 4 on each side.

Clinical Picture in Carcinoma of the Lung.

The 55 cases reviewed in this series were all proved cases of cancer of the lung and all were subjected to either pneumonectomy or lobectomy.

An analysis of the symptoms of these cases is not necessarily a true picture of cancer of the lung in general. Their symptoms are the symptoms of what have probably been the more slowly growing tumours. The majority were squamous epitheliomata. It is obvious then that the clinical picture of the actively growing cancer will be much more rapid in its development.

In this group of patients in whom operation was possible, the average duration of symptoms before admission to the surgical thoracic centre was just over eight months. Case No. 60 (page 833) had had symptoms for only one month, while at the other extreme Case No. 88 (page 1067) would appear to have had a tumour for five years before admission, at any rate, five years previously his own doctor had found an area of dullness in his right chest, which at a subsequent illness three years later was still present; in this area there was found and ultimately removed a carcinoma of bronchus. It is interesting to report that his

original complaint was that of pain in his joints and these pains recurred with increasing frequency and severity throughout the two succeeding years, so that four months prior to admission he was able to work only two days a week and finally he became unable to work at all. This is a typical example of hypertrophic pulmonary osteo-arthropathy; In fact, it is not rare for cases of cancer of the lung to present as arthritis. Eight patients in this series had the osteo-arthropathy syndrome and several have comparatively long histories (Case No. 57 page 750).

Cough. This was the initial symptom in 14 cases (25.4%) and the symptom of most frequent complaint (94.5%). Many patients had had a cough for years, frequently described as a smoker's cough which, by the time of onset of other symptoms, had changed in character, becoming more frequent and irritating in character. It is not surprising that cough is the most frequent symptom. If the tumour is projecting into a major or stem bronchus to such an extent as to narrow appreciably the lumen there will be inspiratory stridor, which when accompanied by cough will give the latter a distinctly brassy character. If the tumour is growing more peripherally in one of the smaller bronchi such

irritation may be absent. Cough also arises as a secondary result of the presence of the tumour. The obstruction caused by the tumour in the bronchus will lead to defective ventilation of the lung tissue supplied by that bronchus, with the result that atelectasis in that segment or lobe will develop, mucus will be retained and stagnation of mucus will promote infection which in turn will cause the development of bronchiectasis, pneumonia or lung abscess. This will lead to the expectoration of purulent sputum, at first small in amount, but if a lung abscess develops and retains some communication with the bronchus it may amount to as much as ten or fifteen ounces a day. If the case is first seen when a large amount of purulent foul smelling sputum is being expectorated the correct diagnosis may well be overlooked and the case labelled as one of lung abscess (Case No. 57, page 805). This is particularly liable to happen if the abscess is in the upper lobe, as it so often is, the tumour being just beyond the trifurcation of the upper lobe bronchus and therefore beyond the view of the bronchoscopic retrograde telescope.

Sputum. This was stated as being the symptom first noticed in 7 cases (12.7%), and was present in

48 (87.2%). The free expectoration of sputum is more a manifestation of damage in the lung distal to the tumour than of the tumour itself. The character of the sputum will depend on the lung pathology from which it flows; in the pneumonic lung it may be rusty or frankly blood stained; in bronchiectasis it will contain yellowish-white plugs and in lung abscess it will be dirty white, profuse and foul smelling.

Haemoptysis. This occurred in 36 patients (65.4%), and was the first symptom noted in 10 (18.1%). It varied in amount from streaking of the sputum on only one occasion[1] through repeated attacks for several days at a time, over a period of weeks[2] to frank haemoptysis[3]. In common with any malignant tumour which ulcerates on an epithelial surface bleeding is a frequent occurrence; it may be capillary in type and therefore small in quantity or it may be from a much larger vessel and cause haemoptysis of half to one pint in amount. This occurred in one case which was too far advanced for surgery and was encroaching too far proximally on to the carina to allow of safe biopsy. The "bleedings" rarely start as the result of a paroxysm

1. Case No. 89 page 1076
2. Case No. 90 page 1084
3. Case No. 90 page 1084

of coughing traumatising the tumour surface, but in the majority, particularly those "bleedings" of any quantity, the cough develops from the irritation of the blood present in the bronchus and, if of considerable amount, it is felt to "well up" in the throat before the coughing starts.

Pain. This occurred in 36 cases (65.4%), and was the presenting symptom in 9 (16.3%) or in 17 (31%) if those cases are included in which pleurisy and pneumonia was a presenting symptom. It varied from a dull ache or a feeling of tightness, through varying degrees of severity to the sharp stabbing pain of pleurisy; pain which was accentuated by coughing and deep breathing. The more severe degrees of pain were usually associated with the spread to the pleura of inflammatory processes following pneumonic change in the lung distal to the tumour. No instance of root pains occurred in this selected series; the occurrence of such pain was generally believed to be an indication of invasion of the chest wall by tumour tissue, an advanced stage of the condition in which so far we have never proceeded to resection, since it would then be necessary also to remove the invaded portion of the chest wall. Similarly no case of the so-called superior sulcus tumour syndrome of Pancoast is included

in the 55 selected examples; as the symptoms are believed to be due to peripherally placed apical bronchial carcinomas in which there is invasion of the supraclavicular and axillary lymphatic glands, the pain being due to pressure on the elements of the brachial plexus.

Loss of Weight. This was recognised by 32 patients (58.1%). It was noted as the primary symptom in 2 instances (3.6%). Weight loss appears to result in the comparatively early case from sepsis in the related section of the lung and not from the tumour itself. In the more advanced cases loss of weight occurs in a similar manner to the cachexia of malignant disease elsewhere in the body.

Breathlessness. This was a symptom of sufficient importance to be noticed by the patient in 28 cases (50.9%) and was the presenting symptom in 4 (7.3%). It usually began as shortness of breath on climbing hills or on going upstairs. Not infrequently complaint was made of being unable to fill the chest properly when taking a deep breath, as Edwards (1946) has emphasised. He believed that the normal elevation of the lung root which occurs during deep breathing was prevented in those cancer cases in which there was fixation of the

mediastinum. Strangely and unexpectedly it was found that the bulk of the tumour seemed to have little bearing on the presence or absence of breathlessness. In Case No. 51 (page 750) the most bulky tumour in the series, there was no complaint of breathlessness, nor in Case No. 88 (page 1067) whose tumour was so large that operative removal was difficult; on the contrary breathlessness appeared to be associated not so much with the tumour bulk as with its site. In Case Nos. 51 and 88 (page 750, 1067) although the tumours by their size must have displaced and interfered with a considerable amount of lung tissue no complaint of breathlessness was made. Both of these tumours were situated towards the periphery of the lung. In Case No. 51 (page 750) the tumour was in the apex of the lower lobe and was arising from a minor subdivision of the apical bronchus. In Case No. 88 (page 1067) the tumour was in the upper lobe and was ulcerating into one of the upper lobe bronchus subdivisions, probably the axillary segment. In short, if the tumour is of large size and of peripheral type breathlessness need not be a symptom. If, however, the tumour is projecting into a stem bronchus or a main subdivision bronchus breathlessness will be an early and outstanding symptom even

if the tumour has not reached any great size; in a site of this proximity any obstruction caused will affect an entire lung or lobe.

Arthropathy. This will be discussed more fully on the section on physical examination, but it must be included here as it was the presenting symptom in 6 cases (10.9%) and occurred in two others (Case Nos. 53 and 91 page 772, 1094). A further 3 cases have since been operated on successfully but are not included as the specimens were used for experimental purposes elsewhere. This is an unusually large number of cases presenting in this way and is at least in part accounted for by the interest taken in this condition by the thoracic surgery unit staff as a result of the successful treatment of Case No. 80, (page 996). The history which is common to all these cases is the development of pain and swelling of the joints usually the smaller joints, fingers and wrist, ankles and toes, but the larger joints are not exempt. Case No. 80 (page 996) was admitted to another hospital for treatment of his arthritis and when in the hospital it was noticed that he had clubbing of his fingers. Despite the absence of respiratory symptoms his chest was X-rayed and a lung tumour was found.

A further 16 cases have been collected by the physician to the unit (T. Semple). It is astonishing to find that half these cases have not only been diagnosed as arthritis but have in fact been under treatment at Rheumatic Clinics for it, the chest condition being apparently silent until the history has been gone into more carefully and some symptom such as increasing cough or occasional haemoptysis recalled. Indeed, in some, e.g. Case No. 80 (page 996) even after the tumour of the lung was discovered careful interrogation elicited no chest symptoms and the only symptom that might have been related to the cancer itself was loss of appetite and the loss of 2½ stones in weight. It is perhaps more interesting still that the cases which survived operation all had improvement of their arthritic symptoms and reduction of subperiosteal new bone formation. Indeed those successfully operated on (Case Nos. 80 and 82 page 996, 1015) returned to normal clinically and on X-ray. One of the cases (Case No. 82, page 1015) was treated by lobectomy and when a secondary deposit developed in the lower end of the humerus his arthritic symptoms recurred in all the affected joints and progressed until his death.

Lassitude and loss of energy. In 3 cases (5.5%), this was the first thing which the patient noticed. In many other cases lassitude or loss of energy subsequently developed at varying intervals after the primary symptom. In the 3 cases in which this was the presenting symptom the patient felt perfectly well otherwise (Case No. 74, 92 and 93 page 943, 1103, 1108), subsequently other symptoms were noted including cough and in one haemoptysis (Case No. 93 page 1108). These patients were unable to undertake work or sport activities without developing tiredness under circumstances where formerly it had been absent.

Pleurisy, Pneumonia and Influenza. In 9 cases (16.3%), the history commenced with a febrile illness diagnosed by their own doctor as pleurisy and pneumonia in 6 and influenza in 3. As a rule the illness did not run the usual course, either it took longer to clear up or one was told that the pneumonia had remained unresolved. The diagnosis of unresolved pneumonia will be discussed fully later, suffice it to say here that if a pneumonia does not clear up in the usual time or if it recurs there must be something unusual in the underlying pathology; that something is commonly a partly or completely obstructed bronchus and the obstructing factor is so

often a carcinoma of bronchus that unresolved pneumonia should be assumed to be due to a carcinoma until the patient is bronchoscoped and the diagnosis proved otherwise. Unresolved pneumonia has been found so frequently in cases which have subsequently been proved to be carcinoma that its occurrence should automatically make the clinician think of carcinoma and not only think of it but take immediate action to prove or disprove it. So often cases with this diagnosis have been watched over for weeks or months and the chance for successful resection has been lost forever. Only when clinicians appreciate this will the results of surgical treatment for bronchial carcinoma improve.

Table No. V.

Summary of Symptomatology.

	Initial Symptom %	Present but not Initial Symptom %
Cough	25.4	94.5
Haemoptysis	18.1	65.4
Pain	16.3	65.4
Pleurisy pneumonia and influenza	16.3	-
Sputum	12.7	87.2
Arthropathy	10.9	-
Breathlessness	7.3	50.9
Lassitude and loss of energy	5.5	50.2
Loss of weight	3.6	58.1

Mason (1949) in a review of 1,000 cases found the initial symptom frequency to be cough 31%, pain 24%, dyspnoea 11%, lassitude 9.5%, haemoptysis 6.7%, and weight loss 3.1%. Comparison with my series shows a similar order of frequency except that haemoptysis occurred in 18.1% as compared with Mason's 6.7% and in this way conforms to the figures of Nicholson (1947), who also found cough and haemoptysis to be the most common initial symptoms.

Brock (1950) rightly points out that cough is by far the most important symptom and if occurring in a middle aged patient hitherto free of cough it is most suggestive of carcinoma. He adds the useful point that the patient's wife is frequently the better informant particularly if the patient has had a smoker's cough for years and claims that it has not altered in any way; commonly she has noticed an alteration in its quality or frequency of which the patient is unaware. He stresses the importance of the usual winter cough which has not cleared up in the summer and that the daily or nearly daily blood streaking of the sputum continuing for weeks or months is practically diagnostic. As Churchill (1948) aptly puts it "in sputum the amount of blood seems insignificant, the regularity and persistence of its

appearance are highly significant".

In regard to the symptom of pain Reinhoff (1947) makes the point that whereas pain is an uncommon symptom of cancer elsewhere in the body it is the third most common symptom in cancer of the lung, occurring in 50% of cases and being overshadowed in frequency only by cough and haemoptysis.

Clinical Examination.

In many of the cases which were subsequently found to be suitable for operation, the clinical examination was entirely negative.

As Brock (1950) states there are only two signs that point strongly to growth, the one is absolute dullness not caused by fluid and the other is bronchial stridor, both are more likely to be found in the inoperable case.

In the general examination of the patient, loss of weight if obvious usually indicates either that the tumour is well advanced and has already disseminated secondaries or that secondary inflammatory changes in the lung are pronounced.

Obvious breathlessness at rest or marked inspiratory stridor usually imply the presence of either a large tumour or one which is encroaching on the carina and therefore likely to be inoperable as does the presence of cyanosis.

Hoarseness should be heard with suspicion and enquiry made as to how long it has been present. If it is of recent onset it will certainly indicate involvement of the recurrent laryngeal nerve by the carcinoma or more likely invasion by related invaded

lymph glands. Occasionally, however, one finds that it is quite unrelated to the present illness and that hoarseness has been present for some years dating from some previous episode involving excessive use of the voice.

Careful search should be made of the lymphatic gland areas with particular reference to the axilla and supraclavicular regions. Invasion of one or more of these glands will be evidenced by their enlargement and/or their hardness. If the matter is in doubt one of the glands should be excised and sections from it examined. This measure has frequently saved a patient from thoracotomy. At the same time as search is made for enlarged lymph glands, the entire skin surface should be surveyed for the presence of even a single pea-sized hard nodule - the first skin secondary - a not uncommon feature of the advanced case; a nodule, which is the herald of many others soon to appear, and which foretells an early demise.

Whilst looking for secondarily invaded glands it is as well to examine also for liver enlargement in case this step be forgotten.

Examination of the Chest.

One cannot begin this section better than by quoting Brock (1950) who, in discussing the physical examination of patients with bronchial carcinoma, states "It cannot be too strongly emphasised that the placing of faith in percussion and auscultation is absolutely wrong: a negative examination means nothing. Only by good radiology can an early diagnosis be made in most cases".

If cases of carcinoma of the bronchus are to be diagnosed earlier, this very important outlook expressed by Brock (1950) must be instilled unceasingly by the physicians into the minds of medical students in clinical teaching.

If positive findings are present on physical examination they will be dependent on two main factors, the size of the tumour and its site in relation to the bronchial tree.

Inspection. If the tumour is a peripheral one, there may be flattening and lack of movement over the affected area[1]. If the tumour is in an advanced state of growth and has produced a "blacked out" lung, the whole side of the chest will be flattened and quiet on respiration

1. Case No. 54 page 779

while the heart will be drawn to the affected side[1]; a similar flattening of the chest will be present if pleural effusion has developed, if it is extensive it may cause bulging of the chest and displacement of the heart to the other side.

Palpation. The axillary, cervical and supraclavicular glands will already have been "covered" during general examination. It is as well first to palpate the position of the trachea in the suprasternal notch and to decide if it is deviated to one or other side. If it is it nearly always indicates that a partial or complete lung atelectasis has occurred distal to the tumour. If this examination is carried out first it is less likely to be overlooked.

In the early case no alteration from normal will be found. In the peripheral tumour and in the late case with partial or total atelectasis the flattening and lack of movement of a section[2] or an entire hemithorax will be confirmed, in addition, depending on the extent of the collapse, reduction or absence of vocal fremitus will be noted[3].

1. Case No. 94 page 1114
2. Case No. 54 page 779
3. Case No. 95 page 1120

Percussion. When the tumour has produced a segmental collapse of a lobe careful percussion may reveal this as a small area of diminished resonance[1]; more often, however, this area will be missed[2]. Dullness confined to a lobe may indicate pneumonic and atelectatic changes in that lobe distal to a tumour[3], while total dullness will be found in those with total atelectasis[4] or with extensive pleural effusion.

Auscultation. Norris & Landis (1938) aptly state "auscultation does not help much".

Abnormal stethoscope findings are again likely to be absent in the early case. As in palpation a segmental collapse may be found and exhibit broncho-vesicular or frankly bronchial breath sounds. When larger areas of lung are involved the findings may be either those of atelectasis or pneumonia and commonly are a mixture of both[5]. The respiratory murmur is likely to be reduced in intensity for if the pathological changes have been sufficient to manifest themselves on examination of the chest surface, inevitably the visceral pleura will be several times thicker than

1. Case No. 80 page 996
2. Case No. 83 page 1026
3. Case No. 96 page 1129
4. Case No. 94 page 1114
5. Case No. 94 page 1114

normal (even to $\frac{1}{3}$" in thickness) in response to the underlying lung inflammation[1,2]. Similary the respiratory murmur is likely to be decreased[3]. If there is central breakdown in the tumour which communicates with a bronchus or if there is a lung abscess distal to the tumour (a not infrequent occurrence) the respiratory murmur may be cavernous[4] and whispered pectoriloquy may be heard.

1. Case No. 96 page 1129
2. Case No. 78 page 981
3. Case No. 54 page 779
4. Case No. 63 page 861

Hypertrophic Pulmonary Osteo-Arthropathy.

This condition as distinct from simple finger clubbing, was first described by Bamberger in 1889 and Marie in 1890 (quoted by Pattison et al, 1951). The original description was "symmetrical osteitis of the four limbs, chiefly localised to the phalanges and terminal epiphyses of the long bones of the forearm and leg, sometimes extending to the roots of the limb and flat bones, accompanied by a dorsal kyphosis and some affection of the joints".

While clubbing of the fingers has been a well recognised sign of pulmonary infections such as bronchiectasis, abscess, pneumonia, empyema and tumour and of congenital heart disease and while it has been reported in cancer of the thymus and in benign chest wall tumours, including fibroma (Hazel, 1940) and lipoma, only in comparatively recent times has it been recognised that this hypertrophic pulmonary osteo-arthropathy may be the first sign and, indeed, the only sign of a bronchial carcinoma. Several papers have since appeared notably by Locke (1915), Campbell (1938), Hazel (1940), Galli & Vitale (1947) and Fried (1948). Six cases presenting in this way are included in this series, two others had it as one feature of their case

and a further three cases have been operated on since this series, giving a total of 9 cases in all. Several of these cases had joint symptoms for many months. The history of Case No. 88 (page1067) extended over 2 years and possibly 5.

Pattison et al (1951) underline the important point that whereas in suppurative conditions of the lung joint symptoms occur some time after the suppurative condition has been recognised, in cancer joint symptoms may be present for six to nine months before pulmonary symptoms develop. Sufficient time in fact to allow of the diagnosis and successful removal of the tumour.

The condition is characterised by pain and tenderness in the joints with an aching sensation in the shafts of the long bones, particularly the tibia and radius, and it is accompanied by a varying degree of joint swelling. The fingers are enlarged, bulbous and may be cyanosed. Sometimes there is a burning sensation in the hands and feet and evidence of endocrine upset such as gynaecomastia and resemblance to acromegaly. The latter findings occurred as reported in the first case of Pattison et al (1951). X-ray examination shows typical sub-periosteal new

bone proliferation especially in the ulna, radius, tibia and fibula; the metacarpals and metatarsals may also be involved. These cases commonly run a mild fever of 99° - 101° which further encourages the erroneous diagnosis of arthritis due to an infective origin.

When removal of the lung tumour at operation has been successful the patients all immediately remark on how much more freely their joints move. Subsequently these patients all returned to normal activity. As Pattison et al (1951) point out although bone changes here are so marked, they are reversible and will disappear entirely if the primary condition is cured. Norris & Landis (1938) deny this, but our experience is at variance with theirs and we have observed that the changes do disappear (Case Nos.80 and 82 page 996, 1015). Hazel (1940) reported seven cases of tumour of the lung with joint manifestations, five were malignant and two were simple. One of the malignant cases had been bedridden for six months and following lung resection the joint symptoms disappeared. Many views have been propounded to explain the development of these appearances. Mauer (1947) believes that the increased sedimentation rate is due to increased

fibrinogen and globulin in the blood; this leads to rouleaux formation of the red cells with, in consequence, great reduction in the available area of the red cells for oxygen exchange. Charr & Swenson (1946) showed that the vascular bed in the skin is increased and widened in these cases, this allows an increased rate of blood flow, which combined with the decrease in oxygen exchange causes tissue anoxia.

Campbell (1938) believed that the reason why only a small proportion of lung cancers developed osteo-arthropathy was due to the location of the tumour in relation to the veins and that if the tumour pressed on or invaded the veins, osteo-arthropathy was more likely to develop. Hazel (1940) reported that 3 out of his 7 cases had definite pressure on or invasion of the veins.

Cases of carcinoma of lung with joint manifestations are appearing with increasing frequency and one feels that in future all cases of arthritis with finger clubbing should have an X-ray examination of chest as a routine measure.

X-ray Examination of the Chest and the Interpretation of Radiographs.

Good x-ray pictures are of vital importance. The routine postero-anterior film must be supplemented by a lateral film. Far too many radiologists are unwilling to take lateral x-rays of patients in whom carcinoma is suspected (probably as a result of the scarcity of x-ray films) even more clinicians are unaware of the value of lateral films in practically all chest lesions[1]. This statement is borne out by the fact that in about 30% of the cases to which one is called in consultation in the medical wards there is no lateral x-ray film.

While postero-anterior and lateral films may be diagnostic of cancer in themselves, quite frequently a shadow is seen, the nature of which is in doubt. This shadow may be clarified by taking a penetrating film to show the trachea and stem bronchi[2]. In these films a tumour of the main bronchi may be seen to project into the bronchus or be seen to distort it by narrowing its lumen[3]. As a rule, however, when doubt remains as to the diagnosis it is necessary to take tomographs.

1. Case No. 97 page 1141
2. Case No. 66 page 884
3. Case No. 84 page 1035

The depth of the tumour is estimated on the lateral film and "body section" films are taken so as to cut through the tumour at 1cm. intervals. By this means Moore (1940) states that it is possible to show the bronchial tree down to bronchi of 3-4 mm. in diameter and thus by this means reduce the number of tumours which cannot be diagnosed accurately by a combination of examinations other than x-ray - a figure stated to be about 35%. Mason (1949) believes that in collapse tomography will fail to show in only a small proportion of cases either a definite mass or a very suspect area of greater density at the apex of the pyramid of collapsed lung tissue.

In general lipiodol examination should be avoided for it is likely to be of little help in tumours which are beyond the main bronchi (which will be seen in any event on bronchoscopy). It may be of help, however, in the upper lobe when the tumour has not been visible on bronchoscopy[1] in which the pectoral segment failed to fill. If a lipiodol examination is carried out it is likely to obscure further x-ray observation in cases in which there is still some doubt (with the more recent measures of treatment of the patient by the physio-therapist immediately after x-ray and by the use of

1. Case No. 83 page 1026

water soluble lipiodol this "obscuring the picture" is likely to become less troublesome as some of the opaque medium can thus be discharged).

In examining chest x-ray films of cases suspected of carcinoma of the bronchus particular attention should first be paid to the type of film received and assessment should be made of the "hardness" of the film. Next the trachea should be located and note taken of its relationship to centrally placed sterno-clavicular joints. If it is deviated to one or other side, the heart shadow in tumour cases will also be deviated to the same side. (This is not necessarily the case in "hard" (i.e. fibrotic) apical tuberculous disease in which the trachea may be considerably pulled across in an S-bend to the fibrosed diseased side without much cardiac displacement, although in total unilateral fibrous tuberculosis the cardiac shadow will also be displaced to the diseased side). The trachea will be pulled toward the side of the tumour. This is a very important diagnostic point in differentiating a "blacked out" lung due to tumour from a "blacked out" hemithorax due to pleural effusion; in the latter the trachea will be pushed away to the other side, that is, away from the "blacked out" hemithorax. An excellent example of "blacked out" lung with deviation to the same side due

to tumour, is seen in Case No. 84 (page 1039). Next the lung fields should be inspected and any abnormal shadow noted. An attempt will be made to assess in which lobe the shadow lies and further, on viewing the shadow in the lateral film, an attempt should be made to decide which segment or segments the tumour involved either by its invasion or by atelectasis distal to its presence[1, 2]. Quite obviously if an entire lobe[3] or lung[4] is involved the situation will be quite apparent. Mason (1949) in his series of 1,000 cases found that 64% showed collapse on x-ray; 40% lobar, 24% total collapse. Quite frequently a triangular shadow with its apex towards the hilum will be seen. This represents an atelectatic segment of a lobe and is due to obstruction of the segmental bronchus at a proximal level[5]. If a series of x-ray films over a period of weeks are available, this segmental collapse may be seen to have developed gradually or in a matter of days; further what was first seen as a segmental collapse may now be seen to have become lobar or even total lung atelectasis. Tumours near the lung hilum

1. Case No. 83 page 1026
2. Case No. 93 page 1112
3. Case No. 54 page 783
4. Case No. 84 page 1039
5. Case No. 83 page 1026

may be particularly difficult to detect particularly when situated on the left side behind the heart shadow, that is, tumours in the lower part of the left stem bronchus and in the bronchus to the left lower lobe[1]. These hilar shadows are usually best seen on the lateral film. Mason (1949) stresses the importance of taking radiographs in different planes and in different phases of respiration if early surgical emphysema due to early bronchial obstruction is not to be missed.

The postero-anterior film should also be observed as regards the level of the diaphragms. There is a considerable variation in these levels from one normal person to another; as a rule the right diaphragm is slightly higher than the left. Any deviation from a slight elevation of the right leaf of the diaphragm above the left will be noted and remembered for further investigation[2] and vice versa. If there is evidence of collapse of a lobe, particularly the related lower lobe, diaphragmatic elevation will quite likely be explained on the basis that the diaphragm has become raised to fill in the potential and actual vacuum caused by the

1. Case No. 66 page 884
2. Case No. 75 page 958

diminution in size of the collapsed lobe[1,2]. On the other hand, if there is no such evidence of lower lobe collapse the cause of the elevation will require to be sought elsewhere and will likely be due to phrenic nerve paralysis. For the requirements of surgery in bronchial carcinoma it is important not to overlook the position and mobility of the diaphragms.

The costo-phrenic angles should be inspected for levelling off as a result of small amounts of pleural fluid; larger amounts of fluid will be immediately apparent on first looking at the films.

In large tumours and in those cases in which chest wall pain, especially root type of pain, has been a feature, particular note will be taken of the uniformity, clean cut appearance and density of the ribs in order that rib invasion be not overlooked.

When there is a shadow involving the middle lobe, an x-ray plate taken with the patient in the lordotic position will often show more clearly an atelectatic middle lobe.

As already indicated, tomographs and a penetrating film will frequently be helpful in showing the site of

1. Case No. 98 page 1151
2. Case No. 55 page 792

narrowing in a main or major bronchus[1]. They will also be helpful in displaying the carina of the trachea and they will show whether the carina still has its sharp inverted-V appearance. Any broadening of the carina will be viewed with suspicion as probably indicating the presence of invaded subcarinal glands which, having enlarged, have pushed apart the right and left main bronchi and so flattened out to a greater or less degree the "knife edge" appearance that the normal carina shows.

Brock (1948 & 1950) stresses the importance of the barium swallow, particularly in elucidating mediastinal shadows especially those lying behind the heart. If a barium swallow is given the patient should be viewed under the x-ray screen and x-ray plates taken for later study. The barium swallow will demarcate the medial configuration of the tumour and if an indentation of the oesophagus is seen on the side of the tumour the likelihood of invasion of the oesophagus by the tumour is apparent and inoperability certain. The barium swallow may also be of help in more peripheral tumours, irregularity and indentation of the oesophageal barium shadow will suggest the presence of invaded mediastinal

1. Case No. 84 page 1039

glands and once again proclaim the inoperability of the tumour. At the 1953 Annual Meeting of the Society of Thoracic Surgeons a paper was given on the use of angio-cardiography to demonstrate the "blacking out" of divisions of pulmonary arteries and veins at levels which indicated inoperability. While this measure was of definite interest it seemed to add little to that obtained from the measures already discussed.

No x-ray investigation of a suspected or diagnosed case of bronchial carcinoma would be complete without examination under the fluorescent screen with particular reference to the mobility of the diaphragm on the affected side. This is particularly important if the diaphragm is elevated, one must decide whether the diaphragm is moving normally downwards on inspiration and upwards on expiration; a movement best demonstrated by asking the patient to sniff through his nose, this accentuates the speed of diaphragmatic movement and thus makes the movement more obvious. This is a very important aid when there is increased density in the lower lobe for such increased density will make difficult the demonstration of diaphragmatic movement. Sluggish movement but movement in the normal rhythm of respiration may simply indicate the presence of

adhesions to the lower lobe. It may, however, foretell commencing phrenic nerve paralysis the result of pressure on the phrenic nerve by invaded mediastinal glands. The absence of diaphragmatic movement is suspicious of phrenic nerve paralysis, and the presence of paradoxical movement is diagnostic of such paralysis.

Bronchoscopy.

This is a vital step in the investigation of cases of bronchial carcinoma. The majority of bronchoscopic examinations in this series of cases have been carried out by the consultant chest physician of the unit (Dr. T. Semple). While it is desirable that the surgeon should himself bronchoscope the patient on whom he is going to operate it is by no means always feasible, because the number of suspected cases is so large as to rule out so time consuming a procedure for the operator; further in a closely knit thoracic team in which each knows and appreciates the ability and judgment of the other it is not essential.

The bronchoscopic examinations were carried out under local anaesthesia, 2% anaethaine with adrenalin for the preparation of lips, gums, buccal cavity, fauces and soft palate and 1% anaethaine and adrenalin for the pharynx, vocal cords and trachea. The secret of success in the preparation of these patients is to take time and to allow the anaesthetic to take effect before proceeding from one step to the next. In general, the preparation is preceded by a capsule of nembutal and 1/100 gr. of atropine half an hour beforehand. Just prior to the preparation, the

patient sucks a lozenge of decicaine.

It cannot be too strongly stressed that if a smooth examination is to follow adequate time should be taken to prepare the patient. When visiting clinics in St. Louis and Philadelphia I was very disturbed to see how restless the patients were during bronchoscopy, on occasions almost to the point of fighting. In fact, this was the one aspect of American thoracic work which left what really amounted to a very bad impression. Obviously insufficient time and care were expended in the preparation of these patients. There is just no comparison between the smoothness and efficiency of the one method and the struggle and difficulty in carrying out an examination at all in the other. It was surprising to find that many units in America did not use the retrograde telescope for viewing the upper lobe bronchus.

Inspection of the trachea is first carried out and attention is paid to its position whether it is in the mid-line or deviated to one or other side. If it is found to lack its usual mobility as the bronchoscope traverses it the explanation may be that it is fixed by secondary invasion of mediastinal glands which are adherent to it. When the carina division of the

trachea into the main bronchi is reached note is taken of its appearance. Its normal vertical position as seen through the bronchoscope may be rotated or distorted by disease or tumour in its vicinity. Its normal knife-edged or inverted-V appearance may be less acute than normal or it may be broadened due to the presence of invaded glands lying immediately beneath the carina and between the stem bronchi indicating inoperability. Even if the affected lung and tumour could be removed, the presence of invaded subcarinal glands even though they were removable, would imply the invasion of lymphatics beyond one's reach and hope of removal.

The carina is by-passed as the bronchoscope enters the bronchus. First the bronchus of the healthy side is inspected and then the bronchus on the diseased side is entered. In very proximally placed tumours this may not be possible as the tumour tissue may be seen choking the bronchus and extending up to the carina itself. If such is the case great care must be taken in removing biopsy material for fear that a portion of the tumour either freed by the biopsy forceps or still attached falls across or into and obstructs the healthy bronchus and causes asphyxia. Sometimes under such circumstances

it may be deemed wiser to refrain from taking biopsy tissue. If there is less than 2 cm. of healthy stem bronchus remaining between the carina and tumour tissue or submucous infiltration of the bronchus wall then clearly pneumonectomy will not eradicate the disease.

The upper lobe bronchi are difficult to see into directly for any distance as the right leaves the main bronchus at 90° and the left at 70°. Thus tumours lying beyond 1 cm. within the upper lobe bronchi are rarely seen by direct vision, this is particularly so when there is atelectasis of the lobe beyond the obstruction; this causes the angle to become more acute as the bronchus is pulled further towards the apex. If a retrograde telescope, previously warmed to prevent steaming, is used, it may be possible to see the tumour. Where there is atelectasis of the upper lobe an artificial pneumothorax will help by releasing its distortion to return the position of the bronchus to normal, a procedure which enabled Arbuckle to obtain a biopsy in the first case of successful pneumonectomy for cancer (Graham & Singer, 1933). If the entire upper lobe is atelectatic the tumour in all probability will be seen protruding from the upper lobe bronchus and biopsy may then be possible.

If the bronchus is normal down to and beyond the upper lobe orifice the instrument's downward passage is continued and the other lobe orifices and their sub-divisions are inspected in turn.

If tumour tissue is seen its exact location is noted and its extent along the bronchus wall; this latter will not be possible if it blocks the bronchus completely. The appearances of the tissue is studied as to colour, the appearance of its edge and its vascularity. The tumour may appear as a nodular or fungating growth or it may be sessile or pedunculated. If the tumour is not very vascular, a portion is removed by biopsy forceps for exact histology. Jackson (1930) found biopsy possible in 75% of bronchial carcinoma while Kramer & Son (1936) proved the diagnosis in 74%. Rienhoff (1947) proved it in 70%.

The bronchoscopic picture is very variable; a trickle of blood may lead to the ulcerated tumour surface, or blood may trickle from a segmental division giving presumptive evidence of a tumour beyond the reach of direct vision.

No true tumour tissue may be seen, instead there may only be submucous infiltration, or partial or complete bronchial occlusion from the bulging inwards

of the bronchial wall due to the pressure of an extrabronchial growth.

When biopsy tissue is snipped away care should be taken to crush the specimen tissue as little as possible. Bronchoscopic histology can be notoriously difficult to interpret and malignancies have been mistakenly diagnosed due to distortion of the tissue removed[1]. It must be borne in mind that biopsy tissue reported as granulation tissue may be from granulation tissue at the edge of or proximal to the carcinoma. In Evarts Graham's first history-making case, the initial biopsy did produce only granulation tissue but two subsequent biopsies produced squamous epithelioma.

Bronchial secretions from the suspected site of tumour should be collected by aspiration, centrifuged, fixed, stained and sectioned. By this means a tumour may be diagnosed when no biopsy tissue has been obtained. Bronchial washings may be collected and examined in the same way. A little water is passed down the bronchoscope to the suspected area; it is then sucked out and collected in a small glass flask fitted into the side of the suction tubing.

According to Holinger & Radnor (1940) 80% of

1.Case No. 117 page 1261

tumours originate in the major bronchi.

In this series of cases, 39 were bronchoscoped in Hairmyres Hospital, 20 (51%) of these were positive bronchoscopies, 7 were indirectly positive and 12 were negative. The comparatively small number of bronchoscopic examinations carried out is due to the fact that many of the cases occurred during the war years when staff shortages were considerable. Now every case is bronchoscoped before operation.

Diagnosis.

The most important factor in making an early diagnosis of cancer of the lung is to think of the disease as being a possibility in patients having one or several of the symptoms of cough, haemoptysis, loss of weight, loss of energy or chest pain. As Brock (1950) points out "one of the gravest errors, which all teachers should concentrate on stamping out, is the impression, still far too prevalent, that a diagnostic feature is that the patient should look as if he had got cancer". The proper education of the medical student to the realisation that frequently before any changes can be detected on physical examination it should be possible to diagnose cancer of the lung by means of ancillary methods of investigation such as x-rays and bronchoscopic examination; in other words, the middle aged or older patient coming for advice with one or other or several of the above symptoms should be suspected of having a carcinoma of bronchus until after full investigation it is proved otherwise. Just as one teaches the student that any one of the following symptoms, loss of appetite, loss of weight, indigestion or pain related to meals in a middle aged or elderly patient should make him immediately think of carcinoma

of stomach; equally cough, haemoptysis or loss of weight and energy should make him immediately think of carcinoma of the bronchus.

Of the symptoms, the most important is cough; it will be recalled that this was the initial symptom in over 25% of the cases and occurred in 94.5%. The development of cough or alteration in the character of a previous cough in a middle aged or elderly patient must be viewed with grave suspicion. Similarly, the occurrence of haemoptysis as a "bolt from the blue" in the same age group of patient should be regarded as most likely to be due to carcinoma of bronchus; it occurred as the first symptom in 18% and was noted in 65%. Pain or discomfort in the chest may be the main symptom in nearly one-fifth of the patients. As has already been indicated, loss of weight should not be regarded as part of the clinical picture although in a very small number of cases it may be recognised by the patient as the first feature of his illness.

Other symptoms that may be of importance include breathlessness, arthropathy and obscure cases of peripheral neuritis which are sometimes found in association with bronchial carcinoma (Denny-Brown, 1948).

On clinical examination nothing abnormal may be

found, particularly in early or in hilar lesions, indeed it is generally true to say that the less abnormality found on examination the more likely is the case to be operable.

The value of good x-rays, postero-anterior and lateral films, supplemented where necessary with tomographs cannot be over-emphasised. Indeed if advances are to be made in the results of surgical treatment in this disease these advances will be made mainly with the aid of good radiological investigation. The radiologist may be unable to give the exact diagnosis of tumour from the picture he sees but he will be able to state that there is an abnormal shadow and this announcement should at once set full scale investigation into motion. With the advent of mass radiography one expected that an advance in earlier diagnosis would have been made but this has not proved to be the case and the number of operable cases of malignant disease discovered in this way has been most disappointing (Mason, 1949), although a number of other space occupying thoracic lesions have been uncovered[1,2].

Any case which has a doubtful shadow seen on x-ray should be bronchoscoped, as should any case which is

1. Case No. 7 page 420
2. Case No. 20 page 516

thought to be a definite carcinoma which may be operable. This procedure will also give a fairly accurate indication as to whether any tumour seen is operable or not, particularly if it is a proximal tumour. Bronchoscopy should always be insisted upon when the tentative diagnosis is one of unresolved pneumonia or pneumonia with delayed resolution - a high proportion of these cases are proved later to be due to carcinoma. Bjork (1947) analysed 112 inoperable cases in one year at the Brompton and Cancer Hospitals and found the average delay between the onset of symptoms and reference to hospital was 8.4 months, delay of 3-4 months due to the patient and 5 months due to the doctor. Mason (1949) found a similar proportion of delay responsibility. In this series of cases the average duration of symptoms was just over 8 months (squamous epithelioma 8.1, adenocarcinoma 6.6, undifferentiated 5.5).

If bronchoscopic examination is negative at the first attempt it may later at a repeat examination give positive findings. It should also be borne in mind that granulation tissue proximal to tumour tissue may be removed at the first biopsy, repeat biopsy may give the correct findings (Jackson 1930 and Graham & Singer

1933); further that an oat-cell tumour biopsy does not necessarily indicate that the main bulk of the tumour is in fact of oat-cell type (Jones, 1947).

It is sometimes tempting to carry out a needle biopsy in cases with a doubtful x-ray shadow but the temptation should be resisted; as Churchill (1940) points out the only justification for such a measure is to determine the character of pleural fluid when it is present and secondly when the tumour is already clearly inoperable. It is a highly questionable procedure to traverse with a needle the pleural space and normal lung tissue in a tumour that may be operable.

The examination of the sputum and bronchial washings for malignant cells by a pathologist skilled in the histological technique and accustomed by long experience to looking for tumour cells in sputum can be of great value and can foretell a high percentage of correct diagnosis. In the Barnes Hospital, St. Louis, I was told that in Evarts Graham's unit they obtained positive findings in about 75-80% of cancer patients.

Positive surgical action should be taken to prove the diagnosis. If, after all available ancillary investigations have been carried out one is left with a middle aged patient with a shadow in one lung of

uncertain diagnosis, a thoracotomy should be carried out and should be regarded as part of the diagnostic procedure (Ochsner et al, 1947). To wait until a positive diagnosis can be made is to court disaster; this is particularly true of shadows in the upper lobes. As Rienhoff (1947) puts it "thoracotomy is not another form of euthenasia, as some physicians still seem to think". At thoracotomy a lump is nearly always felt in such cases and "the only safe thing to do with a palpable lump is to remove it" (Mason 1949); this means that pneumonectomy or lobectomy will be carried out unless the condition is too far advanced. Inevitably by these measures a few lungs are removed for such things as lung abscess and tuberculoma, but as a rule, subsequent examination of the specimen will often show that in any event this was the only possible treatment for the pathological condition found; this is particularly true in chronic lung abscess[1]. At the present time tuberculomata are frequently being dealt with in a similar manner by thoracotomy and subsequent lobectomy or segmental resection. In such cases the youth of the patient, the course of the illness and the appearance of the shadow are regarded as diagnostic

1. Case No. 136 page 1365

even in the absence of tubercle bacilli from the sputum (a relatively common occurrence in tuberculoma).

Differential Diagnosis.

"The conditions which bronchogenic cancer may simulate are legion" (Mason 1949).

As was already indicated in the discussion under diagnosis, unresolved pneumonia, repeated attacks of pneumonia and pneumonia showing delay in resolution should all be suspect; they should be looked on as probable cases of carcinoma of bronchus and measures to confirm or refute this diagnosis should immediately be taken. The most important of such measures is bronchoscopy, no case of this kind should be allowed to continue without this examination being carried out. The persistence of a pneumonic process in a lung lobe almost certainly indicates the presence of some obstruction in the bronchus to that lobe and such persistent obstruction in a middle-aged patient is probably though not inevitably a carcinoma (Case No. 72 page 930).

Even when bronchoscopic examination has proved to be negative it can be exceedingly difficult to decide between a tumour and pneumonia which has progressed to multiple small abscesses, bronchiectasis and fibrosis; in consequence, despite the doubt one may decide that the right line of treatment is to remove the lobe or lung. Frequently resection is later found to have been

the correct and only treatment suitable to deal with the amount of lung destruction present.

In this series there were 6 cases in which a clean cut decision could not be made as to whether or not carcinoma was the correct diagnosis. A few illustrative cases from my series will indicate the difficulties in such conditions.

The solid X-ray opacity due to multiple abscesses, bronchiectasis and pulmonary fibrosis.

Case No. 136 (page1365) is a typical example. Six months prior to admission he had had a cold which left him breathless on exertion with haemoptysis, loss of energy and loss of 10lbs. in weight. There was a dense shadow on x-ray in the apex of the left lower lobe; bronchoscopy was essentially negative. It was decided that he probably had a carcinoma in this area. At operation, I found in this site a hard mass the size of a cricket ball which I still thought was a carcinoma and I removed his lung. When the specimen was examined later the apical segment of his lower lobe showed multiple abscesses, bronchiectasis and consolidation and similar but less extensive changes were found in the adjacent portion of the upper lobe. These changes had been present for five or six months and it is justifiable to assume that the condition would never have cleared up spontaneously.

Case No. 114 (page1241) is a further example of a solid shadow in the left lower lobe seen on X-ray in a patient with a five months history of cough, spit, haemoptysis and weight loss which was, in fact, due to a lung abscess proved by resection of the lobe at operation. Again all the evidence was in favour of carcinoma rather than pneumonia or abscess. Case No. 115 (page1247) had a history similar in type and duration to that of Case No. 114 (page 1241) and on X-ray showed a large ill-defined opacity in the right lower lobe still present five months after the onset of symptoms; the resected lung showed only unresolved pneumonia with a cavity in the apex of the lobe. Case No. 116 (page 1253) is a further example of complete consolidation of right lower lobe due to multiple abscesses.

Case No. 117 (page 1261) was admitted to the thoracic unit in 1943 with a solid middle and lower lobe; bronchoscopic examination revealed the blockage of both middle and lower lobe bronchi to be due to extraluminal pressure. Biopsy was carried out and the tissue was diagnosed by an inexperienced pathologist as oat-cell carcinoma. In consequence, the lung was removed at operation. Subsequent examination of the specimen

showed a lung abscess in the lower lobe without evidence of tumour. Unfortunately the patient died. This case illustrates not only the difficulty in differential diagnosis between the X-ray opacity of lung due to abscess formation and carcinoma but also the vital importance of examination by an experienced pathologist accustomed to bronchoscopic biopsy tissue.

The solid X-ray opacity with a fluid level.

The diagnosis of the solid X-ray opacity with a fluid level seen on the X-ray photographs of a middle-aged patient is fraught with difficulties, for the X-ray appearances may be due to chronic lung abscess, abscess distal to a carcinoma or central degeneration in a carcinoma.

Case No. 118 (page 1264) exemplifies this difficulty. An opacity in the apex of the right lower lobe is seen in the postero-anterior and lateral X-ray films; a tomograph at 3 cm. from the back shows a cavity in the centre of the opacity very similar to that seen in the central degeneration of a carcinoma. Lipiodol failed to enter the apical bronchus of the lower lobe and it was assumed that the bronchus was blocked by tumour tissue. A lobectomy was performed and the lobe was found to have an abscess cavity 5 x 4 cm. in size

surrounded by a thickened rind of lung tissue only .5 cm. in thickness.

Case No. 112 (page 1235) is an example of abscess involving the whole upper lobe of the right lung which was drained externally, the method then in use in 1947. Fourteen days later the patient died of respiratory distress of fairly rapid onset possibly due to the development of a tension pneumothorax through leakage of air into the pleural space or from a "spill over" of purulent fluid into the healthy lung during sleep.

Case No. 119 (page 1273) typifies this difficulty in diagnosis which may be experienced even with the lung open to inspection and palpation at operation. This patient gave a seven month history of cough and foul smelling sputum and loss of weight; she was diagnosed as having a lung abscess of right upper lobe and it was decided to remove the lobe. At operation the lobe was found to be very adherent to the chest wall and to be stony hard. From this it seemed that she had an inoperable carcinoma and not a lung abscess. The chest was closed and she was subsequently sent for X-ray therapy; six weeks later while undergoing this treatment she had several large haemoptyses and died. At autopsy a lung abscess only was found occupying the entire lobe;

there was no evidence of tumour.

Many cases diagnosed as chronic lung abscess are later found to be primary bronchial carcinoma with a lung abscess distal in the obstructed lobe, while yet others are not abscesses at all but broken down tumours the centre of which shows a fluid level on X-ray examination (Case Nos. 56, 57, 62, 63, 67 and 71, page 795, 805, 851, 861, 891, 923).

Case No. 120 (page1278) is an example of a case diagnosed as having a lung abscess which was later proved to have a carcinoma. X-ray examination revealed collapse of the axillary portions of the anterior and posterior segments of the right upper lobe with what appeared to be a moderate effusion in the upper part of the main fissure and in the horizontal fissure. This was regarded as a lung abscess with an interlobar empyema and was drained. He died a fortnight later and post mortem revealed the lesion to be a carcinoma.

From this account of some of the cases encountered at the thoracic unit with X-ray appearances of pneumonia or lung abscess it will be apparent that many of these present the greatest difficulty in distinguishing between carcinoma on the one hand and pneumonia or lung abscess

on the other. It would seem right and proper that all should be regarded as potentially malignant lesions until proved otherwise by full investigation or operative removal. Lobectomy or pneumonectomy would seem to be the correct method of treatment in all chronic cases in which the diagnosis is still in doubt now that these operations can be carried out with a much greater likelihood of survival than at the time when many of the above cases were treated.

The possible grave import of recurring attacks of pneumonia or delay in the resolution of pneumonia in a middle-aged patient has already been stressed and the importance of full investigation in such a case cannot be overemphasised. In 12 cases (21.8%) there was a history of pneumonia or a pneumonia-like illness and if to these are added 5 cases in which the clinical findings prior to hospitalisation in the thoracic unit were of pleurisy (in one at least of which pneumonia was also a feature) a total of 17 cases (30.9%) gave a history of such pneumonia-like illness. Case No. 72 (page 930) is a typical example. During the three months prior to admission to Hairmyres she was twice admitted to hospital diagnosed as unresolved pneumonia on account of four exacerbations of fever and

and chest pain. When I saw the case at this stage, knowing that this was a common premonitory history to the diagnosis of bronchial carcinoma (even for a female aged 43), I advised bronchoscopy, which confirmed the presence of an oat-cell tumour in the lower lobe bronchus. The 12 cases with a definite history of pneumonia all had at least one attack of pneumonia which either did not clear up or if it did, it recurred, in the above case it did so four times. The pneumonic episodes occurred from two to seven months before the diagnosis of carcinoma of bronchus was established; the average was just over 4 months. Obviously a greater awareness of the possibility of carcinoma could have saved the delay of at least two of these months. These 12 cases are Case Nos. 59, 60, 62, 72, 73, 77, 79, 89, 93, 94, 96 and 103 (page 741, 833, 851, 930, 936, 972, 989, 1076, 1108, 1114, 1129, 1181). The cases with pleurisy were Case Nos. 54, 75, 76, 78 and 84, (page 779, 954, 963, 981, 1035).

Pleural effusions and empyemas.

These findings are often only a manifestation of some underlying pulmonary disease, which among pleural effusions frequently and among empyemas occasionally

is a carcinoma which may still be operable. Thus Case No. 121 (page 1284) is an example of a carcinoma underlying an empyema. A year prior to admission to the thoracic unit she had an attack of influenza; subsequently she developed an empyema which was drained on three different occasions, three, five and six months after the onset of her illness. At the last attempt at drainage curetting of the sinus revealed an oat-cell carcinoma.

Conversely many simple conditions may simulate carcinoma at some stage of their development, e.g. such things as segmental lobe collapse from atypical pneumonia or as the result of inhalation of a foreign body such as mucus during general anaesthesia. As a rule the history of the case combined with the progressive clearing of the atelectasis will exclude the probability of carcinoma.

Other intrathoracic neoplasms.

Adenoma may produce distal atelectasis and bronchiectasis closely similar to that seen in many cases of carcinoma; unlike the latter, however, there is frequently a history extending over many years of which recurring haemoptyses, usually in a female patient, is the salient feature. In many of these cases a well-

defined rounded shadow may be seen and if visualised on bronchoscopy it is found to have the characteristic red or plum coloured appearance (Case Nos. 40 and 46, page 654, 707).

Bronchogenic cysts are usually clear cut with a well-defined edge and are frequently situated in the mediastinum; they are attached to the trachea and move on swallowing. They usually occur in children and young adults.

Thymic tumours and disease of the reticulo-endothelial system involving the thymus usually present as a dense, rather lobulated mass fairly centrally placed in the superior mediastinum - such a mass usually projects into both sides of the chest. The lateral X-ray film will reveal the mass to be in the anterior mediastinum (Case No. 107 page 1212).

Neurofibroma (see page 26) gives a dense generally rounded shadow situated, with rare exceptions, in the posterior chest in the region of the paravertebral gutter and as a rule in the upper thorax. An artifical pneumothorax will allow the lung to collapse clear of the tumour and confirm its extrapulmonic site.

Oesophageal pouch, from the X-ray appearances alone, may on occasion present some difficulty in

diagnosis, although the clinical history of immediate vomiting of food is typical. Case No. 122 (page1288) showed a shadow in the right hilar region projecting to the right of the right border of the heart. His complaint was of nausea with vomiting immediately after food. In view of this a barium swallow was given, the responsible oesophageal pouch was outlined and later removed at operation. Case No. 123 (page1294) presented X-ray appearances of a rounded shadow to the right of the mid-line just below the bifurcation of the trachea. This shadow was outlined by barium swallow; it was subsequently removed and proved to be a submucous leiomyoma of the oesophagus.

Case No.109 (page1223) is one of several examples of retro-sternal shadow due to retro-sternal goitres lying in the superior mediastinum - contrary to general belief once they entered the thorax from the normally placed gland all the retro-sternal thyroids passed to the side of and behind the trachea.

Miscellaneous Conditions.

Case No.124 (page1303) illustrates the rounded shadow projecting on both sides of the mid-line which is due to an aneurysm of the first part of the aorta; the diagnosis is suggested by the rim of calcification,

by the fact that it appears to lie in front of the trachea and is non-pulsatile. It is our experience if such a shadow shows pulsation it is not an aneurysm, but some other condition showing transmitted pulsation.

Case No. 110 (page1228) is of interest in discussing the diagnosis of collapse especially of the left lower lobe. The postero-anterior and lateral films alone might mislead one into thinking that this was a case of atelectasis of the lower lobe due to bronchial obstruction. More careful scrutiny of the X-ray films, however, shows no evidence of drawing over to the left of the mediastinum which such atelectasis would naturally cause. In addition, there is some cavitation visible in the left lower zone. Naturally in a boy of 15 one would not without further evidence diagnose the atelectasis (confirmed by failure of the lobe to fill with lipiodol) as being due to obstruction by carcinoma of the lower lobe bronchus, but it is a very useful case to illustrate a pitfall into which one might land in an older patient. The boy has, in fact, a diaphragmatic hernia in which there lies a completely inverted stomach and several loops of jejunum; the hernia almost certainly contains his spleen and probably part of the colon. Further food for thought is provided by his case history

which reveals that he languished for four years in a sanatorium as a case of fibro-cavernous tuberculosis. As he had no symptoms while in the thoracic unit he was allowed home without operation but time alone will show whether the omission to repair his diaphragm was justified.

Certain tuberculous lesions may lead to difficulty in diagnosis, especially the solitary tuberculoma, which presents a peripheral rather rounded shadow simulating a peripherally placed carcinoma; (usually the sputum is negative for tubercle bacilli in such cases of tuberculoma presumably because the lesion is solid and has as yet no patent bronchial communication). Once again the youth of the patient, the site of the mass in the lung apex, the length of history and the clear-cut appearance of the lesion on X-ray will usually justify the diagnosis of tuberculoma rather than carcinoma. Case No.125, (page1307) is an example. While this man, aged 19, was in the Royal Air Force, a lesion in the infraclavicular region of the right lung was found and treated with bed rest. The lesion increased in size and ultimately artificial pneumothorax and adhesion section were performed. Three months later, when his lung was allowed to re-expand, a solid rounded lesion was still present in

the right upper lobe. He was then admitted to the thoracic unit and a right upper lobectomy was carried out. Fig. No. 398 (page 1312) shows the tuberculoma, filled with caseous debris; neither sputum nor culture was positive (with the further experience now gained a segmental resection would be considered adequate at the present time).

Case No. 126 (page 1313) is another example of the more solid tuberculous lesion that might be mistaken for carcinoma. A man of 34 presented with a pneumonic left lower lobe accompanied by left pleural effusion and enlarged superior mediastinal glands. In view of the uncertainty of the diagnosis a mediastinal biopsy was carried out and revealed formative tuberculosis undergoing caseation. Similarly Case No. 127 (page 1316) presented with a cavitated pear shaped shadow in the anterior basal segment of the right lower lobe and a five year history of recurring haemoptysis, but a sputum positive for tubercle bacilli was never obtained. At operation many calcified areas were found in the middle and lower lobes; biopsy of which confirmed the diagnosis of tuberculosis.

A most instructive tuberculous case was Case No.. 128 (page 1322). She was 17 and had been diagnosed in

a teaching hospital as a case of carcinoma of the bronchus. Bronchoscopy was thought to confirm this but the biopsy report labelled the lesion as tuberculous. The right middle and lower lobes had shown progressive atelectasis until both lobes were completely collapsed (Fig. No.401 page1325). At the time of the bronchoscopic examination the right stem bronchus just below the upper lobe orifice was blocked by what appeared to be tumour tissue. What had, in fact, happened and what one has since learned is a not uncommon occurrence was that a tuberculous gland had ulcerated through the stem bronchus lumen to produce a clinical picture very comparable with carcinoma of the stem bronchus (Primary tuberculous complex).

Metastases. Primary bronchial carcinoma must always be distinguished from pulmonary metastases due to a primary growth elsewhere. Case No. 129 (page 1327) was admitted to the thoracic unit with a fairly large, almost cannon ball, shadow in his left lower lobe. This shadow was found to be a secondary from a rectal carcinoma. Case No. 130 (page 1330) had several rounded opacities on X-ray examination in his right lung field; these were metastases from a gastric carcinoma. Multiple small secondaries in the lung fields are illustrated by Case

No. 131 (page 1333); these were from a hypernephroma.

Case No. 132 (page 1341) I feel, is worth including in the discussion of the differential diagnosis, not because it is likely to be mistaken for bronchial carcinoma but because of its great interest. In 1934 at the age of 28, that is fourteen years prior to admission, he had had a seminoma of testicle removed in Dundee Royal Infirmary. Four years later he developed a cough and spit and X-ray examination revealed pulmonary metastases. He was given X-ray therapy treatment. During the subsequent years he had four further courses of X-ray therapy. Nine months prior to admission to the thoracic unit he developed further right-sided chest pain; X-ray examination at this time revealed a cannon ball secondary in the apex of the right lower lobe. Subsequently this mass broke down and was largely coughed up as brownish fluid. On admission, he was left with what looked like a large cystic space with a small fluid level in the apex of the right lower lobe and multiple small opacities elsewhere in the lung fields. The cyst was excised at operation and was found to be teratomatous. The patient was seen in 1951 when he was very fit and still working as a journalist eighteen years after removal of the seminoma. Unfortunately he died in

October 1952 during what was described as an acute asthmatic attack (he had been an asthmatic all his life).

Tumours of the thoracic cage. No discussion of the differential diagnosis of bronchial carcinoma would be complete without mentioning X-ray shadows arising from the thoracic cage which might give rise to confusion. In this respect, Case No. 133 (page 348) is a typical example; on X-ray a shadow was seen at the anterior end of the right infraclavicular region. This shadow was due to a chondroma at the anterior end of the first rib; the rib and chondroma were removed at operation. Case No. 134 (page 352) is a further example, this time of an ossifying chondroma of the third left rib. The lateral X-ray films make the diagnosis of a rib lesion quite clear while examination of the case showed a smooth firm swelling in the axis of the third left rib in the mid-clavicular line (Fig. No. 413 page 356).

It will be apparent from these selected representative cases that not only as Mason (1949) says "the conditions which bronchogenic carcinoma may simulate are legion" but also that many conditions may simulate carcinoma of the bronchus. In general, however, with accumulation of clinical experience, careful case

taking and thorough bronchoscopic and X-ray examination, the diagnosis of bronchial carcinoma can usually be established without much doubt. If any uncertainty remains after full investigation in a case in which bronchial carcinoma is suspected, thoracotomy should be resorted to without further delay in a suitable patient. The operation is much better withstood than most clinicians imagine even when a bronchial carcinoma that proves to be inoperable is found.

Treatment of Bronchial Carcinoma.

Once a patient has been diagnosed as having a bronchial carcinoma three lines of treatment may be adopted; the involved lobe or lung may be removed at operation, treatment by X-ray therapy may be given or simply expectant therapy with no active treatment may be decided on. X-ray therapy as at present available will not cure the patient; undoubtedly the only method of treatment likely to hold out any hope of ultimate survival is surgical. For this reason only surgical treatment will be considered in detail; it is not proposed to discuss at any length either the results of X-ray therapy treatment in this series of cases or to consider more than a few references in the literature on the subject.

The Place of X-ray Therapy in Bronchial Carcinoma.

The place in the treatment of bronchial carcinoma by X-ray therapy is adequately summed up by Moore (1940) "as a choice between radiation treatment of cancer of the lung and its surgical excision, there can be but one, and that is excision". This statement made by a radiologist twelve years ago is even more true today. The surgery of cancer of the lung has made rapid strides in the intervening years but X-ray therapy in its present form is still unable to provide five-year cures in histologically proved cases. The radiologists themselves are the first to admit this fact.

At the present time X-ray therapy treatment is looked on by many clinicians and radiologists alike as likely only to prolong the patient's agony. Undoubtedly it has a place in palliation treatment, this is particularly so in oat-celled and undifferentiated types of tumour. The immediate response can be excellent and it may enable the patient to return to work for a time. Unfortunately the improvement is only temporary.

Holmes (1942) declares that X-ray should always be the treatment of choice in oat-cell tumours because

no case has ever been cured by any form of treatment. Nowadays this is not true as even rare cases of oat-cell tumour have been cured by surgery. Holmes Sellors (1952) referred to a male patient alive 8 years after pneumonectomy for oat-cell tumour. Where such cases are deemed inoperable, X-ray therapy should be used for the relief it can give to many of the distressing symptoms, particularly in those cases in which there is a superior vena caval syndrome with oedema of the head, neck and to a lesser extent of arms, accompanied by breathlessness with gross stridor. Care must be taken in the dosage given as massive doses may kill the patient.

Cases treated by X-ray therapy have survived for as long as five years. At the Hairmyres unit a man was found at operation to have an inoperable epidermoid tumour, he was given several course of X-ray treatment and survived for just short of five years.

X-ray therapy is valuable as an adjunct to pneumonectomy where it has been found impossible to remove some of the tumour tissue or invaded glands. While this treatment probably prolongs life in such cases unfortunately it does not complete the cure. Case No. 74 (page 943) in whom aortic glands could

not be removed developed a secondary in a metacarpal in spite of X-ray therapy. Part of the trouble in giving therapy in these cases would appear to be due to the difficulty of directing X-rays accurately on the area involved. To overcome this, Holmes Sellors advocates the attendance of the radiologist in the operating theatre in order to see and measure distances and angles for subsequent therapy (personal communication). He has even suggested applying markers during the operations to guide the radiologist later. Obviously this will only be an effective measure in those patients in whom there is already no spread beyond the thorax.

X-ray treatment also benefits the case with a bronchus occluded by carcinoma provided irradiation of infected lung is avoided (Holmes, 1942). Following the treatment the obstruction is at least partly relieved and symptomatically the patient is much improved.

As Koenig & Culver (1943) point out, X-ray therapy can be of inestimable value in relieving the pain of bone secondaries. They advocate treatment even in those cases in which there is as yet no evidence of X-ray bone change and if the treatment gives relief a full course should be given in spite of the absence

of X-ray evidence of secondaries.

In 1953 Ormerod renewed interest in the use of radon seeds in cases of bronchial carcinoma which are deemed unsuitable for surgery. The seeds are implanted in the tumour by means of a modification of the magazine inserter originally constructed by Clemenson for implanting radon seeds into the oesophagus. By these measures he has brought alleviation of symptoms and several months prolongation of life to many patients. In a few he has even brought about cure. Out of 100 histologically proved cases, 8 lived for 3 years, 5 lived for 4 years and 3 lived for 10 years (2 of which died of intercurrent disease and 1 is still alive and well 16 years after treatment). For the case unsuitable for surgery this method of treatment would seem to have a definite place combined perhaps with a modified course of X-ray therapy once the bronchus has reopened and drained following the tumour shrinkage due to the radon seed treatment.

Operability.

The proportion of cases of carcinoma of the lung coming to operation out of the total number of cases actually seen varies within quite wide limits from one thoracic unit to another. There are many factors to influence this figure. First there is the catchment area from which the cases are seen. This may consist mainly of patients sent in directly by general practitioners and while many of these cases may be well chosen it is inevitable that many will also be of poor quality where the practitioner has little knowledge of the more exact requirements for a suitable surgical case. On the other hand if the cases sent to the thoracic surgeon come from an area plentifully supplied with general hospitals it follows that these cases on the whole are more likely to show a higher rate of operability. This will be particularly so if these hospitals are teaching hospitals and presumably therefore more knowledgeable of the surgeon's requirements. Again, the thoracic surgeon may have an appointment to one or more of these hospitals and in this way he may see many cases in the general hospital but choose few, which are then transferred to the thoracic unit for final assessment for surgery; in this way most cases will be screened

before reaching the unit and a much higher proportion of cases in that unit will be found suitable for exploration. Further allowance must be made for the individuality of thoracic surgeons, most of whom probably operate only on those cases which before operation seem (as far as one can ever tell beforehand) to be cases in which the tumour can be removed. But there are some thoracic surgeons who deem it their duty (possibly they are right) to perform thoracotomy in cases in which more than a little doubt exists as to the suitability of the case for operation, for example, poorer risk cases because of age or inferior general condition. The bolder type of surgeon thinks, well this old chap is going to die soon but if I operate and am able to remove the tumour I may save his life if he survives the dangers of the post-operative phase. The same is true in the type of case in which the tumour projects well up the stem bronchus; some surgeons may believe that such a case is inoperable, others may hope that a very radical resection will reach beyond tissue histologically (only) invaded by the tumour.

Furthermore the same holds true in respect of operability as distinct from assessment of suitability for operation. The conservative type of surgeon will

close the chest without removing the lung if, for example, he finds a ring of hard glands around the artery or vein near to where his ligatures must lie; the radical surgeon will not be deterred by such findings and will hope by opening the pericardium widely that resection of the vessels at this more proximal level will enable him to reach safely beyond any danger of transgressing tumour tissue.

For these and other reasons I have made no attempt to work out in terms of figures the number of cases submitted to operation out of the total cases seen, nor have I included figures to show the resection rate of the 55 cases in my series with the total number of cases submitted to operation. So many variable factors are in force to influence these figures that they would be of little significance and of even less value.

In the thoracic unit at Hairmyres the routine is for the vast majority of potential cases to be "screened" by either one of two thoracic surgeons or by the thoracic physician in the general hospitals, three of these hospitals being teaching hospitals. In consequence, many of the cases reaching the unit have already been "screened" in other hospitals, in addition nearly all are bronchoscoped in the unit as outpatients from these

general hospitals and in this way a further exclusion of unsuitable cases is made.

The wide range of figures quoted in which operation was advised and accepted by the patient is seen in the following figures. Ariel et al (1950) in 1,047 patients from 1937 to 1947 found that operation was carried out in only 13.4%. Brock (1943 & 1950) found his figures of cases submitted to operation for two and a half years up to 1943 was 33 out of 187 (18%), and for the six years prior to 1949 was 172 out of 800 (21.5%). Mason (1949) on the other hand performed thoracotomy in 353 out of 1,000 cases (35.3%), while Ochsner et al (1947) explored 210 out of a total of 360 cases (58.3%).

The Surgical Treatment of Bronchial Carcinoma.

The Choice of Case.

The choice of case for surgical treatment obviously depends on the material available. Naturally the earlier the case is diagnosed and comes for surgical treatment the better are the chances of success. On the whole, however, the type of case deemed suitable for surgery in the thoracic unit at Hairmyres has been chosen on fairly conservative lines.

The type of case most suitable for surgical treatment should be under 60, in good general condition and with a short history. Such a case will have few, if any, physical signs and the diagnosis will be dependent on the history, the X-ray findings and possibly on visualisation of the tumour by bronchoscopy. He should be free of gland enlargement either general or subcarinal (as evidenced by broadening of the carina on bronchoscopic examination); there should be neither paralysis of the phrenic nor recurrent laryngeal nerves. Frequently the most successful surgical case is one in which a fortuitous shadow is seen in a chance X-ray of chest in a patient with few, if any, chest symptoms, who is subsequently submitted to thoracotomy on a suspected diagnosis of bronchial carcinoma.

Only three cases were operated on over the age of 60. One of these was 65 and was submitted to lobectomy only. As a general rule, a patient over 60 is assessed for operation even more carefully than those under that age. It is true to say that some cases of 65, because of their better general condition, are more suitable for operation than some at 55; as a rule these patients have led a more sheltered life and it is unusual to find a man fit for pneumonectomy much over the age of 60 if he has worked hard physically all his life. In patients over 60 one must pay particular attention to the presence of arterio-sclerosis and coronary insufficiency for such patients following operation are liable to develop auricular fibrillation from the third to the tenth day; the most common post-operative cause of death in this age group, other than the immediate result of the operation, is coronary thrombosis. Case No. 98 (page1144) in the days following his operation for pneumonectomy had had two brief spells of cardiac arrhythmia lasting about half an hour. On the eighth post-operative day his pulse was irregular at the time of the morning ward visit but it later became regular. That evening he suddenly collapsed and appeared to have had an attack of coronary thrombosis.

This was confirmed at autopsy when the left circumflex branch of the coronary was found to be completely blocked and a recent infarction of the left ventricle wall was found.

The elasticity and mobility of the chest is carefully noted and, following education in the correct method of breathing and coughing by physiotherapists specially trained in thoracic work, the vital capacity is taken. If it is unduly low (1000-1200) an artificial pneumothorax is induced to collapse the diseased lung and thus find out if the patient is likely to be unduly breathless if left with only one lung. Obviously one has gained little if one removes a lung containing a carcinoma but is left with a patient who is unable on account of dyspnoea to get out of bed. It has not been customary to operate on patients with either paralysis of the diaphragm or of the recurrent laryngeal nerve. Not to have done so in those with a paralysed diaphragm may have been a mistake; Mason (1949) believes that some of these are the result of involvement of the nerve in inflammatory tissue and not by tumour tissue.

Up to the present, cases with more than a trace of effusion have not been operated on at Hairmyres

as fluid in the pleural cavity has always been regarded as an indication of inoperability. This belief is apparently not founded in fact as many authorities including Mason (1949) and Sellors (1952) have found that even a carcinoma of lung with a blood stained pleural effusion is not infrequently found to be operable particularly if no tumour cells are found in the effusion. If one considers the reason for the development of any pleural effusion it becomes immediately obvious that a lobar pneumonia caused by a bronchial carcinoma is just as capable of producing a serous effusion as a pneumonia from any other cause. In these circumstances the pleura over the affected area of lung will be inflamed or the seat of irritation, this will give rise to exudation of fluid from the pleural surfaces just in the same way as the introduction of iodised talc introduced into the pleura in spontaneous pneumothorax to obtain pleurodesis produces fluid.

Distortion of the oesophagus seen on barium swallow and due to indentation by enlarged and invaded mediastinal glands is regarded as a contra-indication to operation. This is a generally accepted principle (Mason, 1949; Brock, 1950).

Poor general condition, invaded cervical or

axillary glands, or other evidence of metastases are naturally looked on as signs of inoperability as also are too proximal encroachment of the tumour on the carina or gross widening or distortion of the carina due to pressure of invaded mediastinal glands.

Pre-operative Preparation of the Case.

Pre-operative preparation of the patient is of extreme importance. For at least one week before operation he should have intensive instruction in respiratory exercises, in the correct method of coughing and in exercises to maintain good posture following the operation; further he should have postural drainage to empty the bronchial tree of as much sputum as possible. By these means a physio-therapist skilled in thoracic work can improve a case which is on the borderline of suitability for operation (due to bronchitic moisture in the remaining lung) into the grade of suitable for operation. Naturally in such a case more than one week of preparation will be required. Smoking is strictly forbidden.

Any anaemia present is treated by iron and if necessary by blood transfusion preferably with packed cells. Oral sepsis should be dealt with provided such treatment will not delay operation unduly. It is as well to introduce the patient to a B.L.B. type oxygen mask. If this precaution is taken the patient wakening from his anaesthetic to find a familiar piece of apparatus on his face is less likely to struggle to tear it off. Foreknowledge lets him realise that he

is not being smothered and is in fact having breathing made more easy for him by the administration of oxygen. It if it anticipated that respiration after the operation may at first be difficult or if a prolonged and difficult operation is anticipated it is as well to show the patient the oxygen tent and to place him in it for short spells on a few occasions. My personal belief is that the use of an oxygen tent should be restricted to cases in which the maintenance of a good colour is not satisfactorily achieved by a B.L.B. mask (even when a nurse continually holds the patient's chin up). It is not the custom at Hairmyres to use an oxygen tent following pneumonectomy unless the patient is in distress. It is my firm belief that these cases do as well, if not better, when an oxygen tent is not used. I believe that the heat generated within the tent and the feeling of claustrophobia engendered, more than offsets the advantage of the greater oxygen concentration obtained. In any case no allowance is made in the oxygen tent for C.O.2 absorption. Further in these days of nursing difficulties there is the danger of the oxygen running out and an insufficiently experienced nurse not appreciating that this has happened; if such were to occur the patient would be

liable to suffocate in spite of there being a fair oxygen reserve remaining inside the tent after the oxygen supply runs out. If the oxygen ceases to flow into a B.L.B. mask sufficient oxygen will probably still be obtained through the "open to the air" aperture in the mask to maintain life.

Skin preparation should be carried out for 24 hours before operation. Cleansing and shaving followed by spirit and the application of some distinguishing dye-containing antiseptic such as merthiolate. If the chest is painted so as to cover only the side that is to be operated on there should be no danger of operating on the wrong side. If a dye is not used the large cross painted with dye on the top of the shoulder on the operation side as is done by Sellors is very safe, for then it is always seen by the anaesthetist when the patient arrives at the theatre and it is always before him until the patient is "towelled". One cannot overdo the precautions designed to avoid opening the wrong side of the chest, for the patient will be turned through either 90° or 180° when transferred to the operating table (depending on whether the surgeon operates in the lateral or the face-down position). Whatever

method of skin preparation is used once it is completed the chest is wrapped in sterile towels. Penicillin therapy is given for 3-4 days before operation and for 7-10 days post-operatively.

Anaesthesia for Pneumonectomy Cases.

The anaesthesia for the operation of pneumonectomy at Hairmyres has varied with alterations in technique of the actual operation by the surgeon. Until two and a half years ago these operations were carried out in the lateral position and towards the end of that phase a Thomson cuffed bronchus blocker was passed into the left main bronchus when the left lung was to be removed and an endobronchial tube was introduced into the left main bronchus for right pneumonectomy, especially if it was anticipated that there would be a fair amount of soiling either from bronchial secretion beyond the tumour or from the tumour itself. Case No. 84 (page1035) illustrates what can happen when operating in the lateral position if such precautions are not taken. The handling of the lung during the operation forced a portion of the tumour into the opposite bronchus causing asphyxia and cardiac arrest. The patient was hurriedly bronchoscoped and the tumour tissue was removed. In spite of his apparent recovery during the operation he died that night after showing signs of cerebral irritation presumably the result of cerebral anoxia during the operation.

The anaesthetic preparation of the patient varies

a little. Premedication is usually morphine gr. 1/6 and atropine gr. 1/100 given about three quarters of an hour before coming to the operating theatre. A double drip is started into an arm vein and is kept running slowly with saline from one of two bottles. The other drip bottle contains 0.2% procaine which is useful in preventing spasm and cardiac irregularity. Once the operation is commenced the saline is replaced by blood.

On occasion, if a bronchus blocker is to be introduced, a complete local anaesthesia preparation as for bronchoscopy may be used and the bronchus blocker may be placed in position under local anaesthesia. Once it is in situ and inflated, general anaesthesia is commenced. As a rule, however, the bronchus blocker is passed under general anaesthesia. At present resections of lung at Hairmyres are being carried out in the head-down, face-down position. Anaesthesia is induced via the drip by pentothal given in divided doses supplemented by tubarine and pethidine in quantities as required before and during the operation. Gas and oxygen anaesthesia is administered through a cuffed endotracheal tube and controlled respiration is used. The anaesthetist makes himself responsible for the maintenance of a clear

airway, efficient respiratory exchange and adequate oxygenation. He removes tracheo-bronchial secretions by suction obtained through a gum elastic catheter passed down the endotracheal tube. In addition, he performs tracheo-bronchial toilet by bronchoscopy at the conclusion of the operation when necessary. He also supervises the replacement of blood. With the high standard of anaesthesia given and the team work that inevitably goes with it, the surgeon is able to confine all his attention to the operation in the knowledge that he need neither be on his guard all the time for fear that anaesthetic difficulties may arise or that the patient may lose ground to a dangerous level without appreciating till late on that such has happened. He knows that the anaesthetist is constantly watching the blood pressure, pulse rate and other matters and that timely warning of deterioration will be given; he also knows when such warning is pronounced that he must immediately take steps either to give the patient a period of rest from surgical interference or take other appropriate measures. In a well balanced team working together such warnings are called for infrequently.

The Operation of Pneumonectomy for Carcinoma of the Bronchus.

Historical. Tudor Edwards (1932) operated on two cases of carcinoma of lung, Churchill (1933) on one and Sauerbruch on two (quoted by Graham & Singer, 1933); while these cases survived for one or more years only a limited removal of lung was carried out, usually lobectomy. It was not until 1933 that Evarts A. Graham successfully removed the first whole lung for carcinoma of bronchus. The patient was a 48 year old physician who is still, now 21 years later, carrying on a busy obstetrical practice. Graham had intended performing a lobectomy but the tumour extended too far up the bronchus to allow of this being done. It is interesting to have read about and to have heard him discuss his feelings at the time of deciding to try to perform a pneumonectomy. He wondered what would be the effect of tying off the stem pulmonary artery and if doing so would result in the effects produced by a massive pulmonary embolism. To test this out he tied a small rubber catheter round the artery and to his surprise nothing untoward happened. As a result of this historical decision one ties off a pulmonary artery at the present time without a single thought that

this will have any ill effect. Once the lung was removed he inserted seven radon seeds and proceeded to remove the third to the ninth ribs inclusive from transverse process to anterior axillary line. An empyema developed in the upper part of the chest on the ninth day; this required drainage and later removal of the first and second ribs. Since Graham's pioneer work many changes have occurred in the operation of pneumonectomy and several individual surgeons have personally removed two or three hundred lungs for carcinoma.

At the thoracic unit at Hairmyres for the past two and a half years pneumonectomies have been carried out in the face-down, head-down position. At no time has the anterior approach been used. The prone position has several advantages. The operating table is angled at the middle so as to have the head and chest on one side and the legs and feet on the other side of an inclined plane position. The restricting effect this would have in abdominal activity during respiration is overcome by placing a rectangular sorbo rubber pad under the chest and a pillow under the upper thighs, this lifts the anterior abdominal wall just clear of the table and allows abdominal excursion during

respiration. The table as a whole is then further tilted so as to lower the head still further and the patient is strapped on to the table. The advantages of this position are that any bronchial secretion will gravitate up the bronchus into the trachea and if not aspirated by suction it will reach the mouth. There is no tendency for secretion to pass down the bronchus of the healthy lung, nor will any displaced tumour tissue obstruct the healthy bronchus. The ease with which the stem bronchus is reached and can be clamped as the first structure and thus early in the operation prevent the escape of secretions or tumour tissue into the bronchus is a further advantage of this position.

The incision used starts just below the junction of the neck with the shoulder, it runs parallel with and about one to one and a half inches lateral to the spinous processes, it then curves laterally about two inches below the spine of the scapula and extends to just short of the posterior axillary line. By keeping close to the spinous processes the trapezius and rhomboids are cut close to their aponeurotic origin and thus less damage is done to them. A few fibres of the latissimus dorsi are divided. Diathermy is used once the skin incision is made. As a rule the sixth or

seventh rib is removed from transverse process to mid-axilla. The pleura is opened and any adhesions present are divided and if necessary ligated. If the parietal and visceral pleura are adherent the lung is freed by stripping the parietal pleura off the chest wall. The pleura covering the lung hilum is opened and dissected out. The tumour is felt and a decision made as to its operability. First the relationship of the tumour to the stem bronchus is ascertained, clearly it is inoperable if it extends to within an inch of the origin of the bronchus unless one is prepared to remove a portion of the lateral wall of the trachea along with the entire bronchus. Even if this procedure is adopted it is obviously quite unlikely that the spread into the lymphatic network will be eradicated by the operation. In spite of this, pneumonectomy is considered by many authorities to be the correct treatment (if it is feasible) when there is extensive pneumonic change or abscess formation within the lung distal to the tumour. In removing the lung one eradicates the influence of sepsis on the patient - the predominating clinical feature in this type of case. Next exploration of the lymph glands is carried out with particular reference to the subcarinal and the tracheal glands. On the

left side some of the tracheal glands lie beneath the arch of the aorta and if invaded they may involve the vagus and recurrent laryngeal nerves by pressure or actual invasion.

According to Borrie (1952) the lymph gland most likely first to show invasion on the right side is the gland lying between the upper and middle lobe bronchi while on the left side a similarly situated gland is most frequently invaded as it lies between the upper and lower lobe bronchi. On both sides the second most common site is on the medial aspect of the stem bronchus. These findings of frequency of invasion would appear to correspond to one's findings at the thoracic unit at Hairmyres, although no detailed study of this aspect of the disease has been made. In those cases which have been deemed at thoracotomy to be inoperable (apart from those with invasion of chest wall, diaphragm or pericardium) the decision has nearly always been made because the tumour extended too far proximal in the stem bronchus to make removal practicable, or because there was a collar of enlarged and invaded glands around the stem bronchus which either encroached on the tracheo-bronchial junction (thus simulating proximal bronchial invasion) or were adherent to and

sometimes invading the pulmonary artery or, but, less often, the superior vena cava. Less frequently inoperability was claimed because of invaded glands extending too far proximally on the pulmonary veins. The latter could on occasions be overcome by opening the pericardium and by removing a portion of the pericardium with the lung (or even a portion of the auricle) and by tying the veins within the pericardial sac, thus gaining an additional 1-2 cm. of vein. When definitely invaded glands are found in this area further examination generally brings to light other invaded glands at the trachea, in the subcarinal area, or even down the stem bronchus of the opposite lung. Case No. 90 (page 1084) is an instance in which the glands of the lung removed showed no invasion yet there was a large invaded gland lying on the medial aspect of the main bronchus of the healthy lung.

A careful search of all potential gland sites must be made before pneumonectomy is embarked upon for one may proceed to divide some vital structure such as the bronchus or the pulmonary artery and then find that removal of the lung is not possible with safety or with any hope of ultimate cure. If this should happen one

is left in the unhappy position of trying to strip an invaded gland off the pulmonary artery (with the inherent risk of disaster from haemorrhage) or in order to remove the lung one may be forced to retract one's position and cut across tumour tissue. Case No. 74, (page 943) illustrates this type of situation. I had made what I thought to be a careful estimate of whether pneumonectomy was possible or not, and having decided that it was, I had tied and cut all the main structures when I found that I had failed to detect two or three hard glands, the largest of which was no more than half an inch in diameter, lying on the lateral wall of and beneath the arch of the aorta just where it was crossed by the vagus. I was able to remove only one of these glands with safety, the others were densely adherent to and were probably invading the aortic wall and the risk of opening into the aorta was too great. The gland which was removed was replaced by active squamous epithelioma. He was given a course of deep X-ray therapy but he reported fourteen weeks later with a secondary deposit in a metacarpal of the left hand. This was also treated by X-ray therapy but he died in nine months, that is, thirteen months after the operation.

I find it exceedingly difficult and on occasions

quite impossible to tell whether enlarged glands are invaded or not. It is usual, of course, to find quite large glands normally present at the lung root, along the lung mesentery and in the subcarinal area and the mere presence of visible and palpable glands is no indication whatever that the glands are even enlarged from normal. Generally these glands are comparatively soft and elastic, but if there is a pneumonic process or lung abscess formation distal to a tumour these same glands may become enlarged, firm and if much carbon pigment is already present, e.g. in miners, they may even be quite hard. The matter is made more difficult in that when the glands are cut across subsequently they may show areas of dirty greyish-white colour in their more normal bluish-green background, such areas look like tumour tissue but are later found to be free of invasion; if, however, the greyish-white area is harder than the rest of the gland invasion is almost certain. Much depends on the state of the lung before the carcinoma developed. In many other situations of the body it is usually possible from experience to state that palpable glands are or are not invaded, e.g. in carcinoma of the stomach or colon. The element of error to palpation and

macroscopic appearance in the doubtful group of glands in the thorax is liable to be very much greater than elsewhere in the body due to factors such as occupation, previous inflammatory lesions or concomitant sepsis (factors not usually required to be taken into account to any extent in cancer of other sites). In consequence one finds that one frequently proceeds to pneumonectomy uncertain as to whether glands around the bronchus are invaded or not.

The first step in the actual lung resection has already been carried out in order to assess operability, namely opening the pleura all round the posterior, superior and anterior aspects of the lung hilum. If, of course, both layers of pleura have been stripped off the wall of the thorax and mediastinum, it may not be necessary to open pleura as continued stripping will eventually expose the hilum. If this latter method is being used it is as well to remember on the left side that the vagus nerve may strip off the aorta and mediastinum with the pleura and thus will be in danger of division above the origin of the recurrent laryngeal nerve; in the same way damage to the lowest trunk of the brachial plexus must be avoided. As the pleura is dissected off the hilum it will be necessary to

divide the vagus, either its main trunk just below the origin of the recurrent laryngeal nerve or its branches as they leave the parent trunk to reach the pulmonary vagal plexus. Any lymph glands seen are swept distally towards the lung along with any related fascia. It has been our custom at Hairmyres to dissect out the bronchus first in order to clamp it early in the operation and thus avoid secretion or tumour tissue being displaced into the trachea or healthy bronchus by the handling of the lung necessary to dissect out the rest of the hilum. Now that we have altered the position of the patient from the lateral to the face-down, head-down position this is much less likely to happen and to continue this procedure of dealing with the bronchus as a first step may be a mistake in the light of the work of Borrie (1952) and Aylwin (1951). They have shown that there is a high incidence of metastases by vascular spread in carcinoma of the bronchus and both stress the importance of first tying the pulmonary veins before unduly disturbing the lung and its contained tumour in order to tie off other structures. It is generally agreed that vascular metastases occur and are unrecognised before operation, but Aylwin (1951) argues and shows illustrations to

back up his arguments, that some of these vascular metastases may well have been produced by the dislodgement of portions of tumour invading the vein wall during operative manipulations.

The bronchus is dissected out right up to its junction with the trachea and the lower end of the latter is partially cleared in relation to this area of junction, anteriorly, posteriorly, laterally and inferior in order that resection may be carried out under direct vision at this level.

The bronchus is clamped one inch distal to this junction and is cut across flush with the trachea so that no portion of the bronchus is left. The opening in the trachea is sutured by interrupted silk thread stitches. A stay stitch is inserted at the top of the opening in the trachea and another at the carina; these are left long and are used to retract the opening from out of the depths of the mediastinum towards the operator while further interrupted stitches are inserted. From time to time the opening in the trachea is closed by a swab plug in order to allow the anaesthetist an opportunity of fully oxygenating the patient while the stitches are being inserted. It is as well, once the trachea is closed, to insert two further stitches rather

more deeply placed than the initial stay sutures as these by their traction may have caused a little leakage of air at their point of insertion. The two final stitches are so placed as to control any such leakage. When the stay stitch ends are cut the stump recedes out of sight into the mediastinum. I usually try to close over this track into the mediastinum by picking up some mediastinal fascia and suturing it to the lateral wall of the oesophagus. This step of bronchus closure is so important to the success of the operation and to the prevention of post-operative complications that a separate section has been written and included here on the previous methods used and the unsatisfactory results that followed.

Closure of the Bronchus.

For many years and indeed since the first pneumonectomy was performed the successful closure of the stump of the bronchus has been one of the main problems of this operation; a problem which has passed through many phases and has been the subject of many fashions. At one time in the thoracic surgery unit at Hairmyres the problem of the open or leaking bronchus following pneumonectomy had reached such a depressing magnitude that serious thoughts were entertained of abandoning completely the surgical treatment of lung cancer. Many cases "blew" their bronchus at any time from the third post-operative day to three and a half months later. The earlier this accident occurred the more disastrous were the results. If the bronchus "leaked" in the early days a tension pneumothorax usually developed with immediate and profound respiratory and circulatory distress in one whose condition was little fitted to stand what, in even a comparatively healthy individual, would constitute a major catastrophy. If the "leak" did not occur till some weeks later the immediate result did not amount to a disaster but inevitably it was followed by contamination of the dead space by infected material from the trachea with

resultant empyema.

In the early years of this series of cases, that is 1943 to 1946, the importance of this bronchial closure step in the operation was not fully appreciated partly because few cases were being operated on at that time, with the result that the frequency of the complication was not fully realised. During these years it had been the custom to clamp both the proximal and distal ends of the bronchus before it was divided. It was not until 1949 that it was appreciated that this clamp might be crushing the proximal end, that is, the stump which was to be left behind, and so be interfering with its blood supply thus increasing the tendency to subsequent sloughing of the stump with resulting fistula formation. From 1949 a distally placed clamp alone was applied and stitches were inserted above the anticipated line of suture. Division of the bronchus was then carried out and additional sutures were applied to the stump where necessary to make it air tight. At this time only one row of interrupted silk sutures was used to close the end of the bronchus. That this method of bronchus closure was not always successful soon became clear, the most striking example being Case No. 69, (page 907) who on the evening of the day of operation

developed gross surgical emphysema and died 10 hours after the pneumonectomy. The only satisfactory explanation of emphysema of this magnitude is that the bronchus had not been air tight and that the coughing normally present following the operation had added an ever increasing quantity of air to his pleural space from whence it was disseminated throughout the tissues.

In 1949 it was also realised that stitches tied across the long axis of the bronchus might contribute to the sloughing of the stump distal to the stitch by interfering with the blood supply running in the long axis of the bronchus. To obviate this danger the sutures were then placed in the long axis of the bronchus, with the exception of the corners of the stump at each of which one stitch was placed transversely to control each corner.

For a time no post-operative drainage tube was used and accumulations of fluid were removed by aspiration. At a time when the incidence of "blown" bronchus was very high this proved to be a dangerous omission not at first appreciated. The abrupt onset of the "opening" of the bronchus and the catastrophic respiratory and circulatory distress it caused soon made it evident that some safety valve would require

to be used to control its occurrence in the early post-operative days. This realisation was forcibly brought home in Case No. 97 (page1138) who had the misfortune to develop a tension pneumothorax during the night; in spite of his distressed condition an inexperienced night sister failed to rouse the house surgeon until the patient was in extremis by which time all attempts to regain lost ground were unsuccessful and the patient died. From this time onwards a drainage tube was left in the chest and connected to an underwater seal drainage bottle for the first four or five post-operative days. This at least counteracted in part the dire consequences of the complication occurring in the first few days. Today, one would look on a drainage tube left in for so long as liable to cause an empyema by infection reaching the space through the tube.

In 1946 the magnitude of the complication of bronchial fistula was forcibly brought to one's notice. In that year five pneumonectomies and one lobectomy were performed for cancer of the lung; with one possible exception all had bronchial fistula and in the one exception it was suspected that she too had blown her bronchus (Case No. 59 page 826). The complication

occurred from the third to the sixteenth day in the five cases and, of those five, four developed a tension pneumothorax, three dying on the same day directly as a result of this accident, while the fourth died seven days later from the consequent empyema combined with the respiratory and cardiac upset inherent in the open bronchus. It is not surprising therefore that at this time our results from surgery of lung cancer were causing so much depression that thoughts were entertained of giving up surgery altogether in these cases; yet what other form of treatment could be offered to this unfortunate and ever enlarging group of patients? Certainly X-ray therapy seemed of some benefit in the slowly growing well-differentiated squamous epithelioma. Indeed one such patient in whom the diagnosis was confirmed at bronchoscopy had a thoracotomy at which his tumour was deemed inoperable. He was given a course of X-ray therapy and lived for just short of five years. The other type of case which on occasions derived some benefit was the actively growing oat-cell carcinoma in which there were symptoms of superior vena caval obstruction; such improvement was usually short lived and occasionally death was hastened.

Looking back, closure of the bronchus does not

appear to be such a problem but certainly during those early years its solution was hard to find. During visits to thoracic surgery centres in London and elsewhere and in personal discussions at meetings of the Society of Thoracic Surgeons, this topic always came up for review. It was encouraging to learn that other people were having the same difficulty even if to a lesser extent. Following pneumonectomy for bronchiectasis the complication rarely occurred. Why was this so? It was thought that the cancer patient being in an older age group might have a more rigid bronchus or that the bronchial vessels might be arteriosclerotic and therefore that sloughing of part of the terminal end of bronchus would be more liable to occur. In closing the bronchus one realised that one was dealing with a fairly rigid tube, rigid because of the cartilaginous rings which extend more than half way round. Also because of its rigid structure it was not possible to infold the end with the suture. This meant that two comparatively smooth normal surfaces of mucosa were being stitched together and therefore there was no real reason for them to become adherent or to heal over. Rigidity of the bronchus has been overcome in more recent years by removing the most distal

cartilaginous ring (as one has seen done in Crafoord's unit and as was suggested by Brock). The ring is excised with a small scalpel and closure is carried out by using the soft tissue elements of the bronchus. By this means Crafoord was able to invaginate the terminal mucosa into the bronchus.

In view of these difficulties about the middle of 1947 it became apparent that, despite all the care expended on the closure of the bronchus, the problem was still unsolved. Leakage from the bronchial stump still occurred no matter how much care was taken in tying the stitches so that they were neither too tight to slough out nor too loose to allow immediate leakage. Several authorities including Brock (1948) had pointed out the desirability of covering the stump with a flap of pleura which was available as a fringe on the mediastinal aspect of the divided hilar structures. If there was no fringe then a flap of parietal pleura could be dissected off the chest wall and turned across to close over the stump. This seemed to be the answer for which one had been looking. It was tried in three cases and in two of these no fistula occurred, in the third the fistula was delayed for eight days. This was, however, an improvement. While this method of covering

the stump seemed ideal in theory, in practice one frequently found the pleura to be much too tenuous and the passage of a needle through it often left small tears at the stitch holes.

In spite of this slight advance in dealing with the stump one still felt dissatisfied with the suturing of the bronchus itself. Could it be that the eyed needle with the double thickness of thread passing through the eye of the needle was leaving a small hole in the bronchus at the site of each stitch? Quite definitely this was so in some instances for on occasions one could hear the small leak when the anaesthetic bag was gently squeezed to produce a mild positive pressure. In an attempt to overcome this the stitch was used as a double strand in a few cases. There was here, however, the possibility of a further technical difficulty; a double ended suture is more difficult to tie in a confined space than a single ended one and it was found that some of these sutures were not tied sufficiently tightly. To overcome this difficulty special atraumatic eyeless needles threaded with the appropriate thickness of silk thread were manufactured for the purpose. Further, at this time one felt that there was no guarantee that one

interrupted stitch would not cut out and so defeat the care with which all the stitches had been applied. As a precaution against this possibility it was felt that mattress sutures should be passed in the long axis of the stump above the distal row of interrupted sutures and as close as possible to the carina. This additional step would also dispose of a further feature which had caused concern, namely, that the bronchus divided perhaps one inch distal to the carina of the trachea and sutured only at its distal end was left with a blind stump one inch long in which infected sputum would accumulate and cause infection in the suture line and perhaps encourage sloughing. This pocket, in which pus could accumulate, was avoided by applying this more proximal row of mattress stitches (usually three or four) to approximate the bronchial walls. Because of my great interest in this problem of bronchus closure this step in practically all subsequent pneumonectomies was left in my hands.

So it came about that in 1948 the bronchus stump was being stitched without the use of a proximal clamp; that the stitches were being inserted with an atraumatic needle and were of silk thread, that towards the end of that year mattress sutures were being applied as a

proximal row flush with the carina and that the stump was being dusted with penicillin-sulphathiazole powder and whenever possible it was being covered over with a flap of pleura. In 1948 eight pneumonectomies and one lobectomy were performed. The complication was reduced to two late fistulae, one at three weeks and one at eleven weeks. A third case may have leaked at seven weeks, but this was uncertain.

During the first seven months of 1949 four pneumonectomies were performed for cancer, in one the stump of the bronchus was adequately covered over by a pleural flap, in another mattress sutures were used and in neither did a fistula occur. In the other two for some reason no mattress sutures were used and no pleural flap was available; both cases developed a fistula and both a tension pneumothorax. During the same period two lobectomies were carried out; in one the pre-operative diagnosis was lung abscess hence the reason for the less radical procedure (Case No. 56 page 795). of these two cases the above Case No. 56 developed a fistula, but neither case of lobectomy is comparable to the pneumonectomies except to underline the fact that fistula was occurring in these cases as well.

It will be seen from these figures that at this

stage there was still no room for surgical complacency and little encouragement for medical colleagues. About this time during a visit to the London Chest Hospital one heard that Vernon Thomson had overcome the complication by covering the bronchial stump with an intercostal bundle and at that time he had not had a bronchial fistula for two years. This news raised great hopes and the procedure was adopted forthwith. Two ribs were removed to open the chest and the intervening intercostal bundle was preserved and left attached at its vertebral end. At the conclusion of the lung resection and after the bronchus had been closed with sutures (a proximal mattress layer and a distal interrupted row) the anterior end of the intercostal bundle was brought into the hilar area and having been trimmed to an adequate length so as to traverse the chest without tension was sutured as a cap over the bronchial stump. For this purpose the mattress sutures in the bronchus were left long and so arranged that the ends were available for stitching to the intercostal bundle on either side of the stump. Further supplementary stitches were added in order to seal over the bronchus as securely as possible.

Three further pneumonectomies were done in the

remainder of that year; one had an uninterrupted convalescence; one developed an empyema at four and a half months without evidence of fistula formation but necessitating the performance of a thoracoplasty; and one developed an intrapleural positive pressure of +6 -1 on the thirteenth day as the only evidence that a leak had occurred, although an empyema subsequently developed.

By the end of 1948 there appeared to be reason for hope that at last real progress in the solution of the problem had been made.

In 1950 nine pneumonectomies were performed and in all but one of these an intercostal bundle was used; in the remaining case an intercostal bundle was not used as I was not present at the operation. Fortunately a thick layer of pleura was available and this was sutured over the stump. In this year there was no case of bronchial fistula although there was one delayed empyema. Whenever possible the pleura was brought round the intercostal bundle as an additional precaution.

In 1951 the number of cases of carcinoma of the lung suitable for surgery had fallen off considerably partly, it must be admitted, because the physicians were only now realising and reacting to the bad results that

had been obtained up to 1950. While in various centres in America one topic we always discussed was the method and results of bronchial closure. When Burford the Associate Professor of Thoracic Surgery to Evarts Graham at Barnes Hospital, St. Louis, attributed his success in dealing with the stump to the fact that he stripped the bronchus as little as possible in order to preserve its blood supply, this sounded a useful addition to our technique. On return to Hairmyres two pneumonectomies were done, one by Mr. Dick and one by myself by this method. The bronchus was exposed and it was dissected off surrounding structures instead of surrounding structures being dissected off it. This left the bronchus with its fascial covering intact and the bronchial vessels still attached closely to its wall. Both cases had an uninterrupted convalescence, but one reported back some weeks later with a delayed empyema.

Burford's method proved to be satisfactory but it had the great disadvantage that it entailed leaving behind on the bronchus both fascia and lymph glands which according to the rules of all cancer surgery should have been removed with the parent tumour.

In the beginning of 1952 I visited Logan's clinic

at the Eastern District Hospital, Edinburgh and was very impressed with his method of bronchial closure and with his results. He carried out a very complete dissection of the hilar glands, lymphatics and fascia and left the stump of the bronchus very clean. He then pulled the bronchus and the trachea over to the operation side and sectioned the bronchus flush with the trachea, that is, he removed the bronchus immediately below the carina at its inferior aspect and sectioned the bronchus obliquely upwards and outwards so as to remove a portion of the lateral wall of the trachea. The principle involved in this method of resection was to remove all tissue denuded of its blood supply. One had found Brock, writing in Recent Advances in Surgery, and also Allison speak of the fact that any stump of bronchus left behind was a potential danger for leakage as its blood supply came from the bronchial arteries. In dissecting the bronchus free the bronchial arteries at the very least must be stripped up off part of the terminal portion of any stump remaining; whereas if the bronchus is cut off flush with the trachea the blood supply of the tracheal suture line from the inferior thyroid artery is assured. To achieve this high resection of the bronchus the lung and trachea require

to be quite strongly pulled towards the operator, in consequence, when the suture was complete the line of closure would recede into the mediastinum - the higher the line of section the further the suture line would disappear and the more likelihood of it being covered over by mediastinal fat and great vessels. To complete his method of closure Logan stitches the edge of the oesophagus to mediastinal fascia and fat; thus he deliberately covers over the suture line which is left completely out of sight.

In spite of knowing about this method of high section at the junction of trachea with bronchus it had seemed to be unnaturally difficult until one saw it actually being carried out. Only then one realised that the bronchus and the tracheo-bronchial junction could be pulled on and brought to the operation side and into view without causing respiratory obstruction or anaesthetic difficulties through kinking the healthy bronchus.

In short, this method gave a clean dissection of the bronchus and an assured method of closure completed with adequate tissue covering.

In the first five months of 1952 two cases have been treated by this method and both have had an

uneventful convalescence.

The method used to close the bronchus has been discussed here at some length because I am convinced that this is the most important step in the operation of pneumonectomy for cancer.

From Table No. VI it will be seen that, of 30 pneumonectomies for cancer carried out between 1943 and 1949, 14 patients developed definite fistulae and a further 6 probably did.

It was, indeed, a major complication both as regards immediate mortality and prolonged morbidity in those who survived.

Table No. VI.

Pneumonectomy Operations for Cancer.

Year	No. of operations	No. of fistulae	No. of probable fistulae	Method of bronchus closure
1943	1	1	-	single row silk sutures
1944	3	1	2	single row silk sutures
1945	3	1	-	do.
1946	5	4	1	do.
1947	6	2	1	2 cases without fistula had pleural covering
1948	5	2	1	1 case with proximal mattress suture without fistula
1949	7	3	1	All had proximal mattress sutures
1950	9	-	1 late empyema	9 cases mattress proximal row 8 cases inter-costal bundle
1951	3	-	1 late empyema	1 case inter-costal bundle 2 cases no stripping of bronchus
1952	2	-	-	Section of trachea
1952 cases subsequent to this series	8	-	-	Section of trachea

N.B. Immediate operation deaths have been excluded from this table.

Much pre-operative investigation and preparation and hours spent on the operation itself by several members of a thoracic surgery team in one duty or another, combined with the equally heavy and thorough post-operative care necessary may all be of no avail, to say nothing of the disaster that may befall the patient, if the step of closing the bronchus is done carelessly, without due thought to the method to be used and adequate knowledge of the nature of the tissues and their blood supply.

Comparison of the operative mortality figures before and after 1949, taking any death within the first month as an operative death, reflects the great improvement obtained with effective closure of the bronchus. The percentage number of patients dying within one month of operation in the five year period 1944 to 1948 was 48%. From 1949 when more adequate and complete control of the closure of the bronchus was obtained until the present time the operative mortality was 8.6% and in the last two years has been nil.

Further Steps in the Operation of Pneumonectomy.

Once the bronchus has been divided and closed the pulmonary artery is usually cleared. The vessel is more easily dissected out and cleaned and a longer segment of vessel is obtained if the extension of fibrous pericardium on to the artery is picked up, opened and separated off the vessel wall; in this way the length of vessel obtained allows of the application of as many ligatures as are desired. It has been my custom to use a No.2 catgut as a proximal ligature. This ligature is of sufficient thickness to allow of it being firmly tied without fear of it cutting into the vessel wall. If one ties a silk thread ligature firmly one quite frequently sees the vessel wall fracturing and the pale yellow intimal surface presenting. It is for this reason that I prefer the thicker catgut to the silk thread as the former is much less likely to bite into the vessel. Some surgeons who formerly used silk thread as a proximal ligature have had the unhappy experience of the ligature as it was tightened tearing right through the vessel wall (Logan : personal communication). I apply a ligature of silk thread distal to the catgut and a third ligature or a pressure forcep if there is sufficient length of vessel

distal to the contemplated line of section. The proximal silk ligature is then threaded on a needle, the vessel is transfixed and a further knot is tied. If the pulmonary veins or the pulmonary artery are short the distal ligature is also transfixed to prevent it "blowing off". This distal ligature is frequently awkwardly placed in that it requires to be tied on the point of division of the vessel into its lobar branches. It thus lies towards the apex of a triangle within which intra-vascular pressure is directed to the apex of the triangle. The importance of avoiding a distal ligature coming off lies in the fact that the escape of any quantity of de-oxygenated blood into the thorax causes a fall in blood pressure.

Naturally if the vessel is short and the subsidiary divisions come off early one ties these divisions individually. It has not been our custom to open intentionally the pericardium on the left side unless the tumour or glands encroach upon it and a further length of vessel is desired for clear ligation and division. On the right side on the other hand, in separating the close adherence of the pulmonary artery to the superior vena cava one usually opens into the pericardium and thus obtains a much more satisfactory

length of vessel.

Once the artery has been secured and divided the pulmonary veins are next dealt with. When the patient is in the face-down position the inferior vein is most readily accessible and is usually tied first; once it is divided and the lung is pulled in a lateral direction and turned anteriorly the superior vein comes into view. As in the case of the pulmonary artery the veins have a covering of fibrous pericardium the removal of which not only gives an additional length but allows of more snug ligatures being tied. It has not been the routine practice at Hairmyres to open the pericardium and secure the veins intrapericardially but this is done when proximal encroachment of the tumour on the veins or pericardium makes it necessary. On occasions when there is insufficient vein available it may be necessary to suture the vein at its junction with the auricle, or even to suture the auricle wall proximal to the vein junction. Bleeding from the auricular vein opening is not excessive or uncontrollable unlike that from the pulmonary artery.

Now all that retains the lung will be the pulmonary ligament. This is divided and the constant vessel in its substance is secured. If the pericardium has been

opened and a portion of pericardium is being removed the anterior attachment of this will still require to be cut across before the lung will lift out of the chest as will any remaining strands of loose fascia at the hilum (especially round the anterior aspect of the bronchus).

In order to aid obliteration of the space the phrenic nerve is either picked up and crushed or divided between ligatures. It has been our practice to crush it. By the time the nerve regenerates in three or four months the mediastinum will have moved across to the empty space which will have been largely occluded by fibrin.

A final search is made for any bleeding points which are dealt with. The hilum is dusted with penicillin-sulphamethazine powder. A de pezzer catheter is inserted through a separate stab wound in the ninth intercostal space in the scapular line.

Recently a further step has been added to the operation - a step which looks like proving very useful. Before the chest is closed efocaine is injected into the intercostal nerves, 1 c.c. into the two nerves above and two below the excised rib; the injection is made as far posteriorly in the nerve as

possible. 1-2 c.c. efocaine is injected around the intercostal area of the drainage tube. This local anaesthetic is supposed to be effective for three weeks. So far in the cases in which it has been used the wounds have been pain-free and coughing, expectoration of sputum and movement have been unrestricted by pain. Care should be taken to inject the nerve in a lateral direction for fear that there may be a long "sleeve" of dura ensheathing the first portion of the nerve into which some efocaine may be injected and cause a transverse myelitis. This catastrophy probably occurred in a case subsequent to this series; the transverse myelitis so upset the respiratory mechanism, the ability to cough up sputum etc., that the patient died on the fifth post-operative day.

The chest is closed by suturing together the intercostal bundles which remain on either side of the bed of the resected rib. We use non-chromic No.2 catgut for this step though many surgeons use nylon, silk thread or silver wire. The divided muscles are brought into apposition by stitching only their aponeurotic surfaces. I first saw Logan using this method of muscle closure. I tried it in thoracoplasty

wounds and when I re-opened these wounds I was so impressed by the much healthier appearance and more accurate fusion obtained by this method than by picking up the full thickness of muscle (as had formerly been my practice) that I changed over wholeheartedly to this routine. To obtain a neat wound a subcutaneous fine catgut continuous suture is used. The skin is closed by a continuous silkworm gut suture.

20 c.c. of sterile water containing 300,000 units of penicillin and 1 gm. of streptomycin are instilled into the chest through the drainage tube; and 20 c.c. of air are withdrawn. As narrow a dressing as possible is used in order to restrict chest movement as little as possible.

The anaesthetist then passes a gum elastic catheter down the endotracheal tube and sucks out any secretion present. The catheter is withdrawn and dipped in water to wash it through. It is then re-inserted two to three inches beyond the endotracheal tube and both are then withdrawn, suction continuing. Invariably this procedure obtains quite an amount of secretion which was lying around the endotracheal tube and which would otherwise have been missed. The table is levelled and the patient is then turned over on his back.

Footnote to Pneumonectomy for Carcinoma.

Now at the present time in 1953 no discussion on surgery for carcinoma of the lung would be complete were mention not made of the operation of lobectomy. This method of treatment is being advocated by quite a number of surgeons including Sellors (personal communication); Allison (paper given at the 1952 Meeting of the Society of Thoracic Surgeons) and Edwards (Society Thoracic Surgeons 1953). Lobectomy has always been used in poorer risk cases and in those nearing the upper age limit (Brock 1943 & 1950) but now there appears to be a place for its use in peripheral tumours. In addition, Sellors has been using lobectomy in some cases in which glands are obviously not invaded. In this series the three cases in which lobectomy was carried out (and in which the patient survived operation) all died from secondaries within from three and a half to nine and a half months (Case Nos. 56, 63 and 82, page795, 861, 1015). Operative results claimed for lobectomy are so far very encouraging.

At the time of writing the operation for carcinoma of the bronchus where pneumonectomy has been decided on now has many advocates for block-dissection pneumonectomy (Brock, 1948; Allison, 1950; Higginson, 1953). In

this operation every attempt is made to dissect out all the lymph nodes along with a flap of pleura and fascia from the thoracic inlet downwards and round the lung hilum before commencing the actual pneumonectomy; the vessels are, of course, ligated intrapericardially.

Post-Operative care of Pneumonectomy Cases.

Bronchus toilet and oxygen therapy. At the end of the operation when the patient has been turned over on to his back he is usually bronchoscoped if he is in good condition. The importance of this step of bronchus toilet has frequently been stressed and several examples of the necessity for this measure have occurred at Hairmyres (Case No. 84 page1035). As a result of the handling of a lung during the course of an operation for its removal it is quite likely that secretions and on occasions portions of tumour tissue may be broken off and pass into the stem bronchus, thence over the carina of the trachea and down the stem bronchus of the healthy lung. It may be one's practice (and it is mine) to try to clamp the bronchus as the first step of the operation but to do so one requires to free the posterior aspect of the hilum; however careful one may be this entails some traction and pressure on the lung and such manipulations may be sufficient to express pus or necrotic tumour tissue into the bronchus. If this soiling of the bronchial tree occurs in any quantity during the operation an immediate respiratory emergency will occur, indicated by cyanosis and circulatory embarrassment, and will require urgent attention.

A free airway may be regained by applying suction through a gum elastic catheter which is passed down through the endotracheal tube. If this fails to give satisfactory clearance of the airway the endotracheal tube will require to be removed and a bronchoscope passed immediately to remove the obstructing elements under more direct vision. A less serious soiling of the bronchial tree may have occurred gradually during the operation, as for example the gradual accumulation of mucus and a little blood. While not causing any obvious embarrassment to respiration at the time, if it is not removed at the end of the operation it may cause atelectasis of a segment or a lobe of the healthy lung and thus cause the patient extra work to cough up the aspirated material during the first few days. It is true that when the patient's position on the operating table is face-down (prone), head-down (35^{o} tilt) this complication is less liable to occur because aspirated material will tend to drain up the trachea by the action of gravity, but there is always the chance of some soiling of the healthy bronchus and this should be anticipated. During the course of the operation the anaesthetist will repeatedly "suck out" the trachea with the gum elastic catheter. If he feels that the

case has been "more than a little 'wet'" nothing is left to chance and a bronchoscope is passed and complete bronchus toilet carried out.

Transference to bed. The patient's bed is brought to the operating theatre and he is lifted from the operating table on to it. This is done with care in order not to jolt or bump the patient, to do so may have a marked deleterious effect on the patient's blood pressure and general condition, especially if he has not stood the operation well. It was customary at one time to transfer the patient on to a trolley on which he was wheeled back to his bed in a side room; this was found unsatisfactory in several ways. Firstly, the operating theatre is more than a hundred yards away from the siderooms and wards and while such a distance might prove of little consequence to a patient in good condition, for one in poor condition it had a deleterious effect. At the end of this journey the patient had to be transferred to the bed probably by an inadequate number of people with consequent jolting and bumping. Other factors are also involved if the transfer to bed is carried out in theatre there is an ample staff of people under the supervision of the surgeon to see that the patient is gently lifted over on to the bed (which

has been warmed up by an electric blanket right up to the time of its being moved into the theatre). Further, each bed has available an oxygen cylinder and B.L.B. administration mask as a fixture to the bed. The anaesthetist satisfies himself that the patient's oxygenation and colour are good before he allows the patient to be removed. He may consider that oxygen therapy is not required if the patient is almost conscious and full tone of his muscles has returned along with good general condition which is well maintained after several minutes observation. On the other hand, if the patient is unconscious or if he is slightly cyanosed or has had a severe operation which has been poorly withstood, the oxygen therapy is commenced at once and the anaesthetist before he allows the patient to be removed from his care satisfies himself that the B.L.B. mask is working satisfactorily, that adequate and continuous flow of oxygen is being maintained and that the general condition is improving. In this way by transferring the patient to his bed with a fixed oxygen supply, the risk of failure to maintain oxygenation is reduced to a minimum. There is no fear of the mask becoming displaced in the course of a further lift into bed on return to the ward and there is less

danger of the blood transfusion arrangements becoming disarranged. All these details are attended to and seen to be working satisfactorily before the theatre doors close behind the patient's return to the wards. No doubt this all sounds quite obvious and unimportant but to anyone who deals with these cases it will be only too readily appreciated just how important is such a routine. Nothing should be left to chance, no step should be left unorganised; the more rigid the routine the more certain is it to be automatically carried out and become part of the team work of the theatre and nursing staff. It is worth recalling that a patient on whom the operation of extrapleural pneumothorax for tuberculosis had been performed was, as is the custom in these more routine and less major operations, transferred to a trolley for her return to the wards. When she left the theatre her colour was good and she was in good condition. Darkness was falling and some of the corridor lights had not been put on. It is tragic to report that some minutes later when the better lighting in the wards was reached she was found to be deeply cyanosed and despite all attempts to clear the air passages and thus re-establish adequate oxygenation she expired.

There is a great deal to be said for the American idea of having a recovery ward for all theatre cases. It is, of course, much more suitable in their modern hospitals where all their operating theatres are arranged in the battery system as at Barnes Hospital, St. Louis. In such a recovery ward all facilities are immediately available including anti-shock measures, blood transfusion and oxygen therapy. The staff are accustomed to dealing with patients returning from theatre; they can tell you immediately what any particular patients pulse is and how it has progressed since returning from the operating theatre; they know what measures to institute for each particular crisis that arises and any crisis that does arise is not something unexpected. They are trained to expect it and they have frequently treated that crisis before because the recovery ward is their job. Every operated case stays in this ward for 24 hours or longer until recovery from the immediate post-operative phase is complete.

Blood transfusion. The blood transfusion which has run throughout the operation is continued on the patient's return to the wards. The quantity of blood given will range from 2 to 5 or 6 pints of blood according as to

whether much blood was lost during the operation and to how well the patient's recovery from the operation proceeds. Unquestionably, the patient who has his blood loss properly replaced has a much quicker recovery than the patient whose blood replacement has been skimped; this is particularly important in cases of pneumonectomy where there is only one lung to carry out the necessary oxygenation for which an adequate supply of blood must be available. Further the patient who has not had adequate replacement feels tired and listless as any anaemic patient will.

Sedation. When the patient has recovered from the anaesthetic and is complaining of pain, sedation by morphia is used. The most satisfactory method is the preparation of morphine sulphate gr.$\frac{1}{4}$ dissolved in 10 c.c. of sterile water. When the patient becomes restless and complains of pain 1-2 c.c. of the morphine solution is injected into the rubber tubing of the drip and several minutes are allowed to elapse to see if this quantity is sufficient, if not further repeated c.c. quantities are given until the patient is relaxed and comfortable. For the succeeding thirty-six hours omnopon gr.$\frac{1}{3}$ is usually used at four to six hourly intervals if required. Thereafter discomfort can

usually be controlled by veganin supplemented at night by secconal or a combination of medinal and aspirin. Occasionally a patient having difficulty in coughing up sputum because of chest pain has been greatly benefited and coughing encouraged by the administration of a pint of 1% procaine hydrochloride given intravenously. In this way pain is alleviated and coughing becomes possible and is encouraged. (A striking reduction in the amount of sedation required has resulted from the use of efocaine).

Chest drainage. It has been the custom to insert a drainage tube into the chest at the conclusion of the operation. This tube is kept closed for the first four hours to allow the penicillin and sulphathiazole instilled at the operation to achieve some action. The tube is then connected to an under-water sealed drainage bottle. Twenty four hours later the tube is removed and the separate stab wound through which it was inserted is closed by a stitch which was left in place but untied at the time of operation. When the tube is removed 1 gm. of streptomycin and 250,000 units in 20 c.c. of sterile water are injected into the chest. By using a drainage tube for 24 hours one has found that subsequent aspirations are generally unnecessary.

Several cases were treated without using a drainage tube and it was found that not one but several subsequent aspirations were required. This may have been mere coincidence but it always seemed to be necessary. While this matter may at first seem unimportant one must remember that every time the dressing is removed to carry out an aspiration and every time a needle is inserted into the chest the danger of introducing infection is correspondingly increased. At the time when a bronchial fistula was a frequent sequel to pneumonectomy it was necessary, as already described, to leave a tube in for four or five days to await and control as it were the resultant tension pneumothorax; this is no longer necessary now that this complication has been overcome. In visiting the various thoracic centres in America it was interesting to find that opinions were fairly evenly divided between the use or otherwise of drainage tubes in cases of pneumonectomy.

Physiotherapy. Physiotherapy is restarted the day following operation. The great advantage of a few days pre-operative instruction in the correct method of breathing and coughing is now seen. The previously instructed patient has one less worry to overcome in that he knows how he ought to cough and will usually

make a much better attempt to do so in the presence of pain in his wound than will the uninstructed patient. The practice of sitting the patient up who has a cough and spit and making him expectorate what sputum he can is now becoming standard practice in many general surgical wards and is many times more important in pneumonectomy patients. If sputum is allowed to lie in the trachea or stem bronchus it will gradually increase in amount and will sooner or later cause segmental or lobar collapse of the lung. Such a complication in a patient who has already lost almost half of the surface of respiratory exchange in a left and rather more than half in a right pneumonectomy can be a disastrous burden. The accumulation of secretion is evidenced in the dyspnoea and tightness of the chest of which the patient complains and it is often accompanied by a malar flush and a sharp rise in temperature.

It is then the practice to assume that all these cases will have some sputum and a routine for each and all cases is established. In order that the sputum may be loosened inhalations of Friar's Balsam are given. A physiotherapist, preferably the one who has already become known to the patient and who knows some of his

fears and respiratory shortcomings, sits the patient up on the first post-operative morning (all the operations are done in the afternoons) and while supporting the operation wound instructs, encourages and cajoles, if necessary, the patient to cough up the sputum. If the sputum is tenacious and difficult to come some percussion of the healthy lung will help to loosen it. The application of the physiotherapists hands to the chest wall on the healthy side with sudden pressure during the expulsive phase of coughing will also help to bring the sputum to a more accessible area in the bronchial tree from which further coughing will subsequently bring it up. This procedure may be repeated twice or three times a day depending on individual requirements.

In particularly tenacious sputum it may be necessary to help drainage by "tipping" the patient. To do so the patient lies on a pillow under the UN-operated side of the chest and hangs with the head and shoulders over the side of the bed (if the patient is in poor condition the foot of the bed is raised on blocks) in this way the help of gravity is added to the other measures described above. Should the sputum still fail to be displaced it may occasionally be

necessary to pass a bronchoscope under local anaesthesia. The patient is usually too ill and too distressed to be shifted from the bed or to be laid flat and, in fact, the bronchoscope can be passed quite readily with the patient sitting up in bed. The head is tilted back and the chin is held forward as for shaving and the instrument is passed by the operator standing behind the top of the bed. The suction rod is then passed down the bronchoscope and bronchus "toilet" is carried out.

In nervous individuals and in those particularly susceptible to pain it may be desirable to give omnopon gr.$\frac{1}{3}$ half an hour before physiotherapeutic measures are started.

Chemotherapy. For the first ten days the administration parentally of 250,000 units of distaquaine penicillin and .5 gm. of streptomycin is continued twice daily. Should any complication such as the continuance of cough and spit with patchy atelectasis persist the course of antibiotics is extended.

X-ray follow-up. A careful follow-up of the condition of the operated side of the chest is maintained by antero-posterior x-ray films on the day following operation and on alternate days thereafter, latterly

when the patient is able to go to the X-ray department examination under the X-ray screen is all that is required. If in the absence of sputum in the other lung the patient begins to complain of increasing breathlessness it will generally be found that a quantity of fluid has collected in the pleural cavity and may have reached as high as or higher than the bronchus stump. This amount of fluid will have caused mediastinal displacement and consequently respiratory embarrassment. Aspiration of the chest is necessary and gives immediate relief. The space left following pneumonectomy decreases in size with the gradual elevation of the diaphragm following paralysis of the phrenic nerve intentionally produced at operation. In addition the mediastinum gradually shifts across to the operated side and further reduces the size of the space.

If their progress has been satisfactory it has been the custom to allow the pneumonectomies out of bed on the fourth post-operative day. At the Barnes Hospital, St. Louis, these cases were allowed out of bed to pass urine in the evening of the day of operation. Most of their cases were retained in hospital for only fourteen days. At Hairmyres Hospital they are retained for at least three weeks and frequently for a few days longer.

Post-operative Complications.

1. Broncho-pleural fistula.

This has been fully discussed under closure of the bronchus.

11. Empyema.

Empyema may develop in one of two ways, either immediately following and in consequence of the bronchial fistula. This occurred within three weeks of the operation with one exception (Case No. 78 page 981) when it developed at eleven and a half weeks, or it may occur insidiously and when it does so it occurs later in convalescence (in Case No. 58 page 818, it developed after twelve months).

From the experience of the cases operated on at Hairmyres it would seem that soiling of the pleural cavity at the time of operation has not been a factor in the occurrence of the empyema. The method of closure of the bronchus now in use must inevitably permit of the possibility of some infection reaching the pleura while the edge of the trachea is open prior to its sutures being inserted. Only by cutting the tracheo-bronchial junction without a clamp can such a high section of the bronchus be obtained; it follows therefore that the pleura may be infected by droplet

infection through this opening as respiration continues in the other lung. There is always quite a rush of air into the pleura when the tracheo-bronchial junction is cut across. Any such infection appears to be adequately dealt with by dusting the stump with penicillin-sulphamethazine powder and by the instillation of penicillin and streptomycin in fluid form. In no case in the absence of bronchial fistula did empyema develop in the early post-operative days. It may be argued that in the pre-antibiotic years "spillage" and resultant infection were factors in causing bronchial fistula but the incidence of fistula, though high at that time, was no higher than in the first few years during which both penicillin and sulphonamides became available in Hairmyres Hospital.

It seems then that empyema occurring in the first few weeks is directly the result of the bronchial fistula and infection entering the pleural cavity from the trachea.

The empyema which develops apparently slowly and insidiously months after pneumonectomy is likely to be due to a small leakage from the stump, a leakage of air and infected sputum. Despite the assumption that the empyema is due to leakage in no case of delayed empyema has such leakage been demonstrable on lipiodol X-ray

examination. Case No. 93 (page1108) is a case in point. He, however, heralded the imminence of the empyema by coughing up one of the silk stitches which had been used to close the bronchus. Case Nos. 58 and 93, (page 818, 1108) had been discharged fit and well from hospital some weeks prior to the onset of infection. Similar instances have occurred in a small proportion of pneumonectomies for bronchiectasis. With the method of high resection of the bronchus (virtually tracheal resection) now being used and because the suture line retracts into and is covered over by mediastinal structures, delayed empyema should not now occur. If it does, the assumption that delayed empyema is due to minute leakage from the stump will have been proved to be erroneous.

Clinical Features and Treatment of early and late empyema following pneumonectomy.

The premonitory symptoms of early empyema are those of the bronchial fistula which precedes it. A persistent cough accompanied by blood stained sputum in a patient with pyrexia of unexplained origin is the usual history (Thomas, 1951). Once the fistula occurs the patient coughs up large quantities of fluid - the contents of the operated side of the chest. Before many hours are

past the fluid which had been initially serous or blood stained now becomes frankly purulent. As mentioned in the section on closure of the bronchus a tension pneumothorax may develop and give rise to rapidly increasing dyspnoea and cyanosis in one who is already only able to hold his own in the early post-operative days. It is vital that the occurrence of a tension pneumothorax should immediately be recognised and treated. Under-water seal drainage should be established through a wide bore needle inserted in the second interspace anteriorly. Once facilities are available a catheter is inserted at the same site.

If no tension pneumothorax develops the essential in treatment is to prevent the patient's trachea and bronchial tree from being flooded by fluid from the pleural space. This can be prevented initially as soon as there is any suspicion of fistula developing by the nurses laying the patient over on the operated side. I am quite convinced that once a fistula has occurred (and that implies fistula-cum-empyema) a drainage tube must be inserted at a suitably dependent point, usually the eighth or ninth intercostal space posteriorly. At Hairmyres Hospital it has been our experience that

failure to drain an empyema invariably allows inhalation and aspiration of the pus into the remaining lung with the inevitable development of broncho-pneumonia (Case No. 86 page 1050).

Once bronchial fistula and empyema become apparent a progressive deterioration of the patient's condition occurs. There is marked loss of weight, loss of appetite and energy with troublesome cough and persistent quantities of sputum. Pyrexia of 101°F. with corresponding increase in pulse and respiratory rates. The general condition becomes so poor that one is left with the feeling that the patient was better off with his carcinoma untreated and that his condition had been made worse by removing his lung. A bronchial fistula following pneumonectomy very rarely closes by itself and if it is going to close it will do so within a few hours. Undoubtedly the large proportion of operative deaths, i.e. deaths within one month of operation in the years up to and including 1948, were the direct result of bronchial fistula though quite a number died as a result of the empyema which developed following the bronchial fistula.

Some of the cases surviving beyond one month after operation and therefore not included as operative deaths

died in the same way and for the same reason; these cases include Case Nos. 61, 71, 78 and 95 (page 842, 923, 981, 1120). Their deaths were due to the continued discharge of pus and, in consequence, the persistent loss of fluid and protein.

It will be recognised that the development of an empyema greatly prejudices the possibility of survival. Conversely it will be appreciated that the greatly improved survival rate since 1948 is in large measure due to the reduction and subsequent elimination of the complications of bronchial fistula and empyema.

Late empyema usually occurs after the patient has been discharged home in good condition and may not occur until many weeks later. The symptoms are characteristic and include cough and spit, shivering with pyrexia of 101°F. or 102°, loss of appetite and weight and loss of general condition. The general practitioner looking after the case may consider that the patient has developed influenza or a chest cold and prescribe treatment accordingly; in this way valuable time is lost and the patient's general condition becomes progressively worse (Case Nos. 58, 93, page 818, 1108).

The letter sent to the practitioner when the patient is discharged from hospital should not only contain information about the operative treatment he has had while in hospital and his general condition on discharge but also instructions to inform the surgical thoracic unit immediately if the patient becomes ill; particularly any illness occurring in the first few weeks. In this way much valuable time will be saved and the treatment of the empyema started before the patient has lost much ground. Late empyema has not occurred since tracheal section of the bronchus was started.

A mixed flora of organisms is usually found in the fluid of both early and late empyema. Initially staphylococcus aureus may be the only organism but very soon streptococci and bacillus coli or bacillus pyocyaneus make their appearance.

Treatment of Post-pneumonectomy Empyema.

The first essential in treatment is the relief of any tension pneumothorax present. Such relief must be immediate, continuous and certain. It is not sufficient to establish drainage without being certain that the escape of air is continuous, if the tube

blocks or becomes kinked the tension will redevelop as occurred in Case No. 89 (page 1076) who developed gross surgical emphysema when this happened. In this case the emphysema was, as is usual, most marked over the chest, in the neck and in the right breast overlying the operated side of the chest. His breast became distended to female proportions.

Adequate drainage of the empyema should be instituted as early as possible. If early drainage is established the danger of "spillage" and broncho-pneumonia in the other lung is prevented and loss of general health is reduced to a minimum. Drainage is established at a dependent level, the correct position being first determined by screening the patient in the postero-anterior and lateral positions. As a rule in the eighth or ninth intercostal space in the posterior axillary line. If, by the time the empyema develops, the space has been reduced greatly in size drainage may require to be established at a higher level in the axilla. A de pezzer catheter is inserted through a trocha and cannula under local anaesthesia.

A suitable antibiotic to which the organism is sensitive is given; if there is a mixed flora the sensitivity of the various organisms may require a

combination of antibiotic drugs. In some instances penicillin may be the drug required, but after some days and with the appearance of new organisms a change to chloromycetin, aureomycin or streptomycin may be necessary (within recent months terramycin has been found most valuable). It is essential that tests for drug sensitivity of all the organisms present be carried out every few days as one finds the sensitivity may change quite quickly. To these measures of treatment should be added adequate vitamin intake and high protein diet supplemented with drinks of milk in which is dissolved a dessertspoonful of powdered egg flavoured with chocolate to individual taste.

Once adequate drainage has been established and drug therapy commenced a considerable improvement in general condition will be noted, particularly is this so in a delayed empyema which has been neglected. The temperature will settle, the toxic appearance will disappear, the cough and spit will markedly decrease, the appetite will improve and some weight will be regained. In the delayed empyema if treatment is continued an eventual balance will be reached between the patient and his chronic infection, a balance beyond which no improvement without further surgical

intervention can be hoped for, and a balance which will be lost if drainage is discontinued. In the years in which bronchial fistula and empyema occurred in the early post-operative days no further surgery was ever possible as the patient's general condition was always too poor. Surgery in delayed empyema usually became possible some weeks after the establishment of adequate treatment by which time the size of the infected space had often decreased considerably with drainage.

If a bronchial stump of some size had been left at operation a thoracoplasty was performed as soon as the patient had regained sufficient strength. The extent of the thoracoplasty depended on the size of the empyema space and usually involved the removal of the upper six or seven ribs to allow adequate inward collapse of the chest wall and scapula.

If a delayed empyema were to occur (which has not happened so far) in cases in which the bronchus had been removed from the trachea, i.e. high mediastinal resection of the bronchus, the operation of choice would probably be pleurectomy with complete resection of the empyema space. Obviously this type of operation would be quite unsuitable in a case in which a stump of bronchus had been left or in which an intercostal bundle had been used to cover over such a stump. In these pleurectomy

would almost certainly lead to further injury to the bronchial stump and the redevelopment of fistula and empyema.

I am quite convinced that if an empyema develops early radical surgical treatment should be instituted after an adequate spell of drainage and chemotherapy.

If radical surgery is delayed the empyema wall becomes greatly thickened and any form of collapse therapy without empyema resection becomes virtually impossible. The parietal pleura becomes densely fibrous and greatly thickened and may be to as much as 3 cm. in thickness.

With the advances in surgical technique of pneumonectomy one hopes that empyema and corrective operative procedures for empyema will be no longer required.

The Operative Mortality in Carcinoma of Bronchus.

In the early years of the surgical treatment of carcinoma of the bronchus the operative mortality was high, but in recent years with better choice of case, improved technique and surgical experience the mortality figure has shown a steady and progressive improvement.

Tudor Edwards (1946) stated that he had had 12 post-operative deaths in 66 pneumonectomies, an operative mortality of 19%, but in the two and a half years immediately preceding the publication of his report the operative mortality had been nil. Brock (1948) had an overall operative mortality of 18% but in 1950 he reported that in his last 100 cases the operative mortality was 9% and in the last 40 cases death occurred in only 2, both of which were poor risk cases. Ochsner et al (1947) reported an operative mortality of 24.8%, this figure was made up of the mortality before 1942 which was 44.5% and after 1942 it was 19.6%.

The earlier publications report figures ranging from 20-45% with an obvious decline in this figure in the more recent years reported.

In this series of 55 cases there were 16 deaths within one month of operation giving an overall operative mortality of 29%. In the years 1944-48

the operative mortality was 48%, from 1949 to July 1952 the operative mortality was 6.3%. Since December 1950 there have been no deaths in 13 pneumonectomy operations for carcinoma and there has been only one operative death in the last 25.

The Analysis of the Operative Deaths.

Operative death was considered to have occurred if the patient died within one month of the operation. This appears to be the practice of other writers. Thus there were 16 operative deaths which are detailed in the following table.

Table No.VII. Operative Deaths.

Bronchial Fistula	7
Surgical Shock	2
Probable Haemorrhage	1
Cardiac	2
Pneumonia	1
Surgical Emphysema	1
Cerebral anoxia	1
Unknown (probably fistula)	1
Total	16

Bronchial Fistula. The seven cases occurring with bronchial fistula should not occur with the present method of tracheal section of the bronchus. In the last 13 consecutive pneumonectomies no fistula has

occurred, there being only one in the last 25 operations for carcinoma.

Surgical Shock. One case of surgical shock occurred in 1947 (Case No. 88 page 1067), the other in 1948 Case No. 50 page 741). The case in 1947 had a bulky right upper lobe tumour and difficulty was experienced in resecting it. If this situation arose now I would resect or "shingle" more than one rib. Better access would have been immediately obtained by shingling a rib above and, if necessary, one below or by removing a large length of a second rib. Case No. 50 (page 741) might not have died if the method of adequately replacing blood loss as soon as it occurs had been carried out as is done today.

Haemorrhage. Only one death can be directly attributed to haemorrhage (Case No. 99 page 1154). I was not present at this operation but apparently blood appeared in the patient's mouth at the close of the operation. He was bronchoscoped and the blood was sucked out, but shortly afterwards bleeding recommenced and in spite of further aspiration he became pulseless and died.

Surgical Emphysema. Case No. 69 (page 907) died of gross surgical emphysema 10 hours after the operation. This must have occurred from faulty and incomplete

closure of the bronchial stump allowing a positive pressure of air to be built up within the chest. This might have been overcome if it had been spotted at once and if the drainage tube had been released and allowed to "blow off" into the under-water seal bottle. It is the practice at Hairmyres to keep the tube clamped for four or five hours, that is, until the patient is fit to sit up. There is no very clear justification for keeping the tube clamped for this length of time but it is felt that it gives the penicillin-sulphamethazine solution some time to act before most of it escapes with the drainage fluid.

Cerebral Anoxia. This occurred in Case No. 84 (page 1035) and resulted from cardiac arrest, the result of asphyxia during the operation due to tumour tissue blocking the bronchus of the healthy lung. This complication should be less likely to occur now that the cases are operated on in the prone position with the additional precaution of tilting the patient head-down.

It will be seen from this discussion that many of these deaths should not occur. If these cases were operated on today it is reasonable to suggest that the seven deaths due to bronchial fistula would not occur;

of the three due to shock and haemorrhage one (Case No. 88 page1067) and possibly two, (Case No. 99 page1154) would probably be saved. Likewise the death from gross surgical emphysema and the one due to cerebral anoxia are avoidable, the former by the greater care taken in dealing with the bronchus and the latter because of the better positioning of the patient on the operating table. This fact of great reduction in mortality at the present time is borne out by the previously stated fact that from 1949 to July 1952 the operative mortality was 6.3%. In the last 25 pneumonectomies there has been one death and in the most recent 13 of these there has been none. In fact, most thoracic surgeons now have an operative mortality which compares favourably with gastrectomy for carcinoma of the stomach.

The Length of Survival after Surgical Excision.

In this series of 55 cases 39 survived operation. Of these 12 died in the first six months and a further 12 in one year, leaving 15 survivors. This number was further reduced by 2 deaths in the second year, 1 in the third and one at $3\frac{1}{2}$ years (from carcinoma of the prostate, Case No. 54 page 779). Eleven cases are still alive. A further 7 cases have had lung resection for cancer since these 55 cases were reviewed; of these two are dead and five are surviving from one to two years.

Table No.VIII. The Length of Survival of those Cases still living in this group of 55 cases.

1 case	alive at	18 months
1 case	" at	22 "
2 cases	" at	27 "
3 cases	" over	3 years
1 case	" "	4 "
1 case	" "	$4\frac{1}{2}$ "
1 case	" "	$5\frac{3}{4}$ "
1 case	" "	$6\frac{1}{4}$ "

In the light of advances in surgical technique 4 of the 39 cases surviving operation should have lived longer. They all died directly as a result of the hazards of the early operation. They all died from empyema following a bronchial fistula and merely appear as "survivals" because they lived longer than one month. One of these cases as a terminal illness

developed a perforated duodenal ulcer but was unfit for operation (Case No. 83 page 1026).

Tudor Edwards (1946) had 5 out of 66 pneumonectomy patients alive over five years (7.5%), four of whom had survived for from 8-10 years. Brock (1948) had 8 out of 101 (8%) resections for cancer alive over five years and at the time of writing 55 of the 101 cases were still alive. Mason (1949) had four out of 33 patients alive after operation over four and a half years. Ariel et al (1950) had a 26.5% survival after one year and a five year survival rate of 7.1%. Reinhoff reported in 1947 a 9% survival rate after five years and in 1950 that 34% survived from one month to sixteen years.

Taylor & Waterhouse (1950) have collected survival figures from many centres and find the corrected survival rate to be 13.7% of those cases who could have survived for five years.

The heaviest toll from metastases occurs within one year and according to Borrie (1952) amounts to 62%. Taylor & Waterhouse (1950) found it to be 52.7%. As the years go by and the third year of survival is past the sharp decline of survival figures gradually flattens out and if survival to this length of time is achieved

the chance of five year survival is reasonably good.

The success or otherwise of surgical treatment depends very largely on two factors, namely the type of tumour cell, and whether or not invasion of lymph nodes has occurred at the time of operation. Borrie (1952) found that 71% of the undifferentiated tumours, including oat-cell, were dead within 1 year of pneumonectomy and only one survived beyond 3 years, whereas only 30.5% epidermoid tumours died within one year and 26% survived from 3 to 9 years. When lymph nodes were involved he found 85% were dead in 3 years, if the nodes were not involved 66% were dead in 3 years. The absence of lymph node invasion is no sure criterion of lengthy survival for he found that 20 cases dying within fifteen months of operation had had no metastases at all but in these cases he found the growths had penetrated deeply into the vein wall or had even fungated into the vein lumen. An upper lobe tumour appears to be more favourable for only 13% have invaded lymph nodes. In regard to X-ray therapy following operation, he found the survival time in the undifferentiated group was in no way affected. In the epidermoid group post-operative therapy was of doubtful value, 2 out of 13 survived over 5 years with node invasion, yet 2 out of 14

without node involvement survived 5 or more years; whereas 9 others survived as long without therapy.

Summary of Bronchial Carcinoma.

The clinical, pathological and operative features of 55 cases undergoing resection for carcinoma of lung have been discussed in detail. The clamant importance of such features in the history of cough or the alteration of a cough already present, recurring small haemoptysis, breathlessness, loss of weight and energy in a middle aged patient must be stressed, further the recurrence on one or more occasions of pneumonia in such a patient must be viewed with profound suspicion as being indicative of an underlying malignancy. The necessity for full investigation including postero-anterior and lateral X-rays with penetrated and, where necessary, tomographic pictures is self evident. These investigations should be supplemented by bronchoscopic examination. If after all these investigations have been carried out and do not clearly exclude carcinoma then in the case in which there is a solid shadow in the lung whether peripheral or causing segmental or lobar collapse thoracotomy should be carried out as soon as possible for experience gained in the past has shown that the majority of such lesions will surely prove to be due to carcinoma.

With the advent of tracheal section of the stem bronchus the much feared complication of bronchial

fistula with death in the early days from tension pneumothorax and prolonged morbidity in the subsequent weeks from empyema has passed completely. At the present time the operation of pneumonectomy in competent hands and in a well chosen case will survive provided he avoids such cardiac complications as coronary thrombosis risk of which is, however, quite substantial. Should the case prove to be inoperable the patient will stand the operation as well as any laparotomy. That cure of the disease in a suitable case is possible is evidenced by the survival of two cases in my series for more than five years. If a patient survives for three years (with or without invaded lymph nodes) he is likely to survive for five.

Further although the overall mortality is 29% in my series of 55 resected cases between 1942 and 1952, with improvements in technique (particularly bronchial closure) and pre- and post-operative care the operative mortality should now not exceed 5%; in the last 25 pneumonectomies carried out there was only one death (some of the latter are subsequent to the series of cases recorded here).

Summary and Conclusions.

In reviewing this series of intrathoracic cysts and tumours I have endeavoured to extract from the mass of experience certain general principles which I submit should govern the diagnosis and treatment of these lesions.

Neurofibroma and ganglionic neuroma. These tumours show a noteworthy similarity in their radiological appearance, their sites of origin and their histological structure. The X-ray appearances are so characteristic that a pre-operative diagnosis can be made with confidence. They usually present a dense, rounded clear-cut shadow in the posterior superior mediastinum, discovered as symptomless tumours on fortuitous X-ray examination, or because of cough and dyspnoea the result of pressure on the trachea or pulmonary tissue. These neoplasms should be removed even though symptomless for they will continue to grow, until ultimately operation may become much more difficult from the increased size, the development of adhesions to adjacent structures and the prolongation of the tumour into the intervertebral foramina. There is an undeniable risk of malignant change if they are left alone.

Dermoid cysts occur in the anterior mediastinum,

they may be symptomless but they may produce symptoms from pressure on adjacent structures. They should be removed before they become infected.

Pulmonary cysts may be congenital or acquired; they may be intrapulmonary, if they are not they will have attachment to a bronchus or the trachea. A chronic lung abscess may cause difficulty in diagnosis as bronchial epithelium will grow into and line the abscess wall, when this happens even histological examination may be unable to show whether the condition is a true cyst or a healed lung abscess. When diagnosed the cyst should be removed lest it should rupture into a bronchus and become infected. Lung cysts have a wide range - they may be solitary and reach a large size or they may be small and multiple as in fibrocystic disease of the lungs, when a whole lung or only one segmental bronchus may be involved. Before proceeding to treatment every endeavour should be made to distinguish them from hydatid cysts for should a hydatid cyst be ruptured during operative removal dire consequences will follow from sensitisation and the development of daughter cysts.

Bronchial adenoma tends to present a fairly distinctive picture. Unlike carcinoma, it occurs

predominantly in females and is characterised by recurring haemoptysis usually of small amount and commonly over a period of years. If there is extensive intraluminal bronchial growth the clinical picture will have, in addition to haemoptysis, many of the symptoms of bronchial obstruction including cough and episodes of recurring pneumonia. If the tumour is large enough to be seen on X-ray examination it will present a solid clear-cut rounded shadow in close association with one of the major bronchi, there may be visible evidence of segmental or lobar collapse distal to the tumour. The tumour will usually be seen on bronchoscopic examination as a red or plum coloured growth - crisp when cut and tending to bleed easily. It is as well to warn the pathologist when adenoma is suspected for if such warning is omitted the tumour may be reported as an oat-cell carcinoma and operation declined as unlikely to be curative or an unnecessarily extensive resection performed where lobectomy might have served. Infrequently, extirpation of the growth may be achieved through the bronchoscope but there is a tendency to recurrence and the need to treat the diseased distal lung usually demands surgical excision.

Bronchial carcinoma. As in carcinoma elsewhere

the most important problem is that of earlier diagnosis. An inescapable conclusion from the case reports is that delay in surgical treatment is the greatest barrier now existing to surgical success, delay before the patient consults his doctor and, alas, an even longer delay before the patient reaches the surgeon. It is axiomatic for success that one must think of the diagnosis of carcinoma of the lung long before that diagnosis is clinically obvious. Much could be achieved by educating the public, but even more by educating physicians, practitioners and medical students to grasp the significance of cough (or alteration in a cough already present), breathlessness, haemoptysis, loss of energy and loss of weight in a middle aged or older patient. Cancer of the lung should be assumed as a strong probability until proved by thorough investigation to be absent; all the more since cancer of the lung now substantially exceeds in frequency cancer of the stomach in males. Further it cannot be too strongly emphasised that one should not expect to find any abnormality on clinical examination, and that to wait for such abnormality to develop courts disaster. Recurring attacks of pneumonia or delay in pneumonic resolution should be

regarded as probably resulting from intrabronchial obstruction, very likely the result of carcinoma, until full clinical, radiological and bronchoscopic investigation has proved the contrary.

The comparison of appropriately sectioned lung specimen with the X-ray films has made possible the understanding of certain features seen on these films, e.g. the "blacked-out" and retracted lung due to blockage of the main bronchus; the wedge shaped shadows the result of segmental or lobar collapse consequent on obstruction of the smaller though still major bronchi. Further one has been able to demonstrate the great value of lateral X-ray films, provided they have sufficient penetration. A tumour which is hilar in site in the postero-anterior view and therefore likely to be inoperable may be seen in the lateral projection to be clear of the hilar structures and therefore operable; on the contrary a shadow just outwith the hilum on the postero-anterior film may visibly encircle the hilum when seen from the side.

Great progress has been made in anaesthetic methods and surgical technique. Now that the anatomy and vascular supply of the tracheo-bronchial junction is properly understood and granted due respect the

disastrous consequences of a bronchial fistula following pneumonectomy seen in the earlier years no longer occurs. The advent of antibiotics has added greatly to the security of convalescence by protecting the patient from empyema and contralateral pneumonia; in the prevention of the latter, physiotherapy plays no mean part.

One can claim with confidence that an early case of carcinoma of bronchus in reasonable general condition will survive the operation of pneumonectomy, and if he lives for three years without recurrence he is likely to be cured of this fell disease.

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PULMONARY ADENOMATOSIS

BY

H. E. HUTCHISON AND K. FRASER

From the Department of Pathology of the University and Western Infirmary of Glasgow, and the Thoracic Surgical Unit, Hairmyres Hospital, Glasgow

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PULMONARY ADENOMATOSIS

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FROM THE DEPARTMENT OF PATHOLOGY OF THE UNIVERSITY AND WESTERN INFIRMARY OF GLASGOW, AND THE THORACIC SURGICAL UNIT, HAIRMYRES HOSPITAL, GLASGOW

ADVANCES in thoracic surgical technique in recent years have brought within sight the possibility of cure, by radical excision, of localized forms of malignant disease of the lung. This has stimulated interest in pulmonary neoplasms, one consequence of which has been the intensive study of the rather ill-defined group of so-called alveolar-cell tumours, which includes the condition known as pulmonary adenomatosis.

Alveolar-cell tumours are rare ; the first mention of these neoplasms was made by Malassez as long ago as 1876, the first British case being recorded in the following year (Finlay and Parker, 1877), and yet by 1942 Neubuerger and Geever could find only 25 cases in the world literature, to which they added 2 more. During the last decade, however, the improved prospects of surgical treatment have stimulated interest in these growths and Swan (1949), in presenting 9 cases of his own, found that 26 cases had been published by others since Neubuerger and Geever's review in 1942.

Progressive involvement of the lung substance is usual in untreated cases, but all gradations are met with between highly differentiated tumours of low malignancy apparently amenable to surgical treatment and diffuse carcinomas. Therefore, recognition of this uncommon condition is now of practical therapeutic importance and so the following description of a recent case is presented.

CASE REPORT

CLINICAL.—The patient was a 36-year old married woman who, six months prior to admission to Hairmyres Hospital, began to be easily tired. The feeling of lassitude persisted and was followed, about a month later, by a sharp attack of what seems to have been pneumonia. This began with a rigor and a bout of coughing productive of frothy sputum ; there was pain in the lower part of the right side of the chest on deep breathing, but later the pain moved to her right shoulder and then became so severe that injections of morphine were necessary to obtain relief. Her sputum was white and frothy and never purulent or blood-stained. She was treated with sulphonamides but made only a partial recovery from this illness, which kept her in bed for four weeks. Four months after the onset of her symptoms she was admitted to the local hospital, where a patchy consolidation of the right lower lobe was found on X-ray examination. In hospital she became worse and, although some improvement followed penicillin treatment, pain and lack of energy persisted and the consolidation of the right lower lobe remained unchanged (*Fig.* 1).

On admission to Hairmyres Hospital on Jan. 2, 1951, her lack of energy was obvious and she was slightly dyspnœic even at rest in bed ; pain, worse on deep breathing, was still present in the right lower chest. There was no cyanosis and no clubbing of the fingers. Respiratory excursion at the right base was reduced and the percussion note was impaired there and in the axilla.

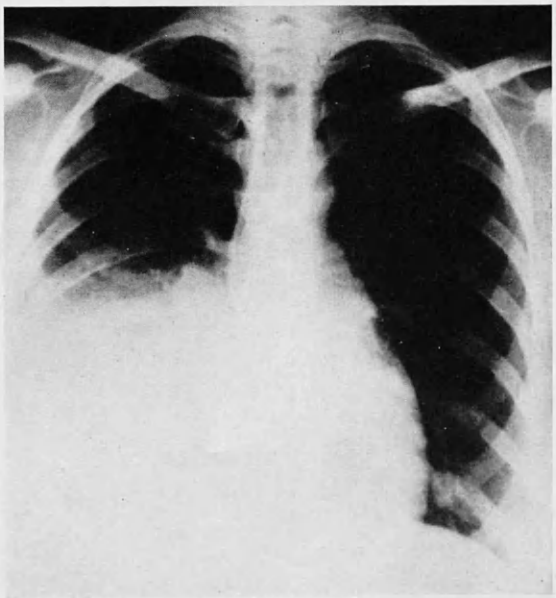

FIG. 1.—Pre-operative radiograph showing diffuse consolidation of right lower lobe. A few poorly-circumscribed opacities are seen in the upper part of the lobe.

Over these areas vocal fremitus and vocal resonance were increased and the respiratory murmur was bronchial ; at one point bronchophony was heard and there were many crepitations at the height of inspiration. Radiographs of the chest showed consolidation of the right lower lobe with probably involvement of the middle lobe.

On Jan. 10 she was bronchoscoped by Dr. T. Semple, who reported : " Trachea and carina normal. Left stem bronchus normal. Right bronchial tree normal except that the right upper-lobe orifice is rather more obvious than normal. There is a continuous flow of clear mucus from the apical segment orifice of the right lower lobe. All the other orifices were dry and normal." She had been having penicillin since admission but without benefit.

AT OPERATION.—On Feb. 13, under pentothal, cyclopropane, and gas and oxygen anæsthesia by Dr. G. Robson, the left bronchus was blocked. The chest was opened through the bed of the seventh rib by Mr. Bruce M. Dick. The upper lobe was found to be free, but the lower and middle lobes were adherent to the chest wall

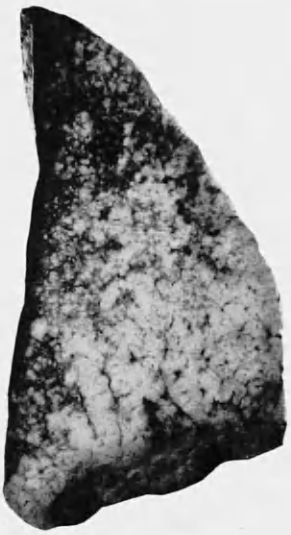

FIG. 2.—The cut surface of the surgical specimen. (× ½.)

and to the diaphragm. The lower lobe was entirely replaced by a firm carneous mass which was broken into in stripping the lobe off the chest wall and showed an appearance like placental tissue, i.e., in places it was firm and had a papilliferous architecture. In addition, multiple small nodules were observed scattered throughout the middle lobe, particularly in its medial segment, so that it looked as if the disease process had started in the lower portion of the lower lobe and was gradually spreading upwards through the whole lung. No enlargement of the hilar glands was noted. The lower lobe was removed by dissection lobectomy and the chest was closed.

Following operation her progress was satisfactory apart from a massive venous thrombosis of the left leg. This eventually healed and she went home after 10 weeks.

THE SPECIMEN.—The gross external appearance of the specimen has been described in the operative findings. On section the major portion of the lower lobe was found to contain pale tumour of a regularly lobulated appearance, but, towards the periphery and in the upper part of the lobe, the neoplasm was present in the form of multiple

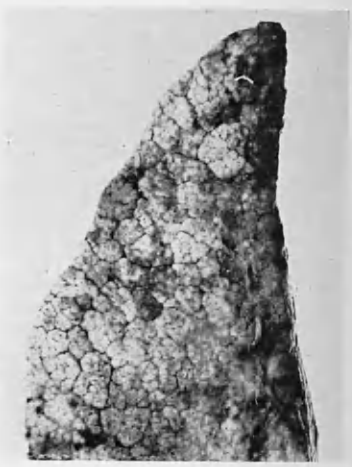

FIG. 3.—The pleural surface of the specimen. (× ½.)

small nodules. These varied in size from some about 1 cm. in diameter, which from their lobulated outline seemed to have been formed by the coalescence of smaller nodules, through infinite gradations to others so small as to be scarcely discernible by the unaided eye. It will be observed (*Fig.* 2) that the distribution of the growth in the lung follows a pattern and that the nodules are not scattered haphazardly throughout the lobe. This appearance suggests that by the growth and coalescence of these small nodules the more uniform replacement of the lower part of the lobe has been produced, involvement of the lateral and upper parts being more recent. Nowhere is there an obvious relation to larger air-passages as a site of primary origin for the growth. It is noteworthy that even where the tumour is most extensive the lobular markings of the lung are still apparent and that there is no necrosis or evidence of other degenerative change.

On the pleural surfaces both diaphragmatic (*Fig.* 2) and costal (*Fig.* 3) pale areas of tumour show through

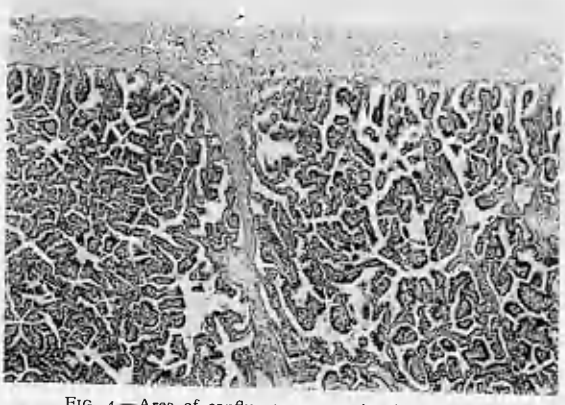

FIG. 4.—Area of confluent tumour showing failure of the neoplasm to invade the pleura or to destroy an interlobular septum. H. and E. (× 37·5.)

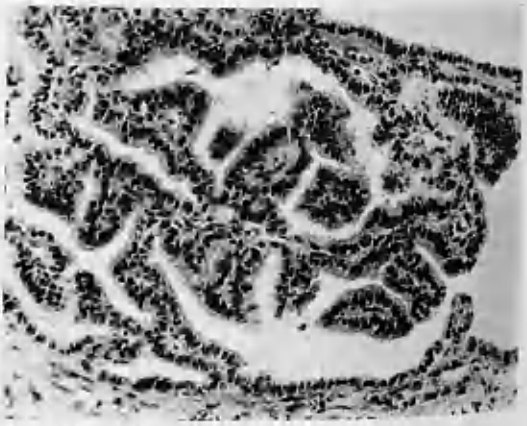

FIG. 5.—The papillary structure of the growth is illustrated both in *Fig.* 4 and in this photograph at higher magnification, when the regular arrangement and general characters of the epithelial cells can also be appreciated. H. and E. (× 217·5.)

the serosa. There is, however, no invasion of the pleural surfaces by the tumour. A few old adhesions are present, and slight recent hæmorrhage is seen, doubtless the result of manipulations during operative removal of the lung.

It is fortunate that the material on which the description of the pathological changes is based was obtained at operation. Because of this the pathological process is

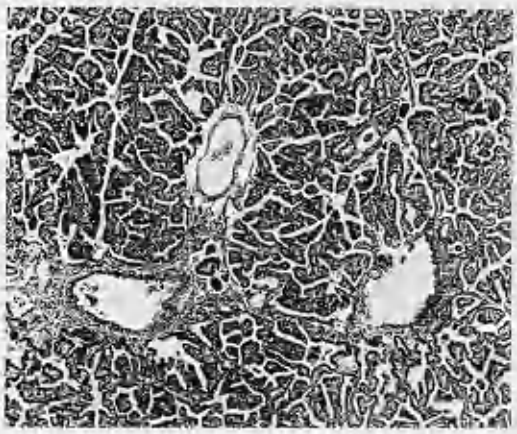

FIG. 6.—Two small bronchioles and a pulmonary vein clearly recognizable in an area of confluent tumour. Note the absence, however, of the alveolar framework of the lung, which appears to have been completely replaced. H. and E. (× 24.)

available for study in a pure form uncomplicated by the presence of secondary infection, which is a common terminal event in the natural history of this disease.

Pathological Histology.—On microscopical examination the lung substance in the basal part of the lobe seems at first sight to have been completely replaced by tumour, the most striking architectural feature of which is the papillary structure well shown in *Figs.* 4 and 5. In some places, however, on close examination the alveolar framework can still be recognized, more fibrous than normally, forming the stroma of the growth, but generally this is not so. Although the alveolar pattern is no longer distinguishable in most areas, it is noteworthy that the pleura has not been invaded and that the interlobular septa have also been preserved (*Fig.* 4). Indeed, both these structures are more prominent than normal owing to fibrous thickening. Furthermore, small bronchioles can still be distinguished even in areas which at first sight appear completely replaced by tumour, as in *Fig.* 6. These features indicate that the growth has only a limited power of replacing the normal parenchyma. At higher magnification the tumour cells (*Fig.* 5) are seen to be cubical or low columnar and are arranged with great regularity in a single layer. They are non-ciliated and only occasionally mucin-secreting. The size of the cells varies little ; the cytoplasm is faintly eosinophilic and the rather oval nuclei lie at about the same level, centrally, in each cell and are of uniform fairly dense appearance. Indeed, the uniformity in appearance of the growth in different areas is a striking feature and this applies not only to the individual cells but also to their general arrangement. There is a complete absence of anaplasia, no mitotic figures are observed, and there is no evidence of lymphatic permeation by the tumour cells.

In the upper and more peripheral parts of the lobe the essentially nodular character of the growth is well shown (*Fig.* 7). Here small nodules of tumour lie among lung alveoli which are little altered or show a mild catarrhal reaction ; some contain recently shed blood, the result of operative trauma, but nowhere is a lipophage reaction prominent.

In brief, pathological examination discloses a multiple nodular growth, with areas of confluence, which proves on microscopical investigation to be an epithelial tumour of highly differentiated architecture with only very restricted powers of replacing the lung structure.

SUBSEQUENT COURSE.—Soon after her return home she began to be troubled again by cough, shortness of

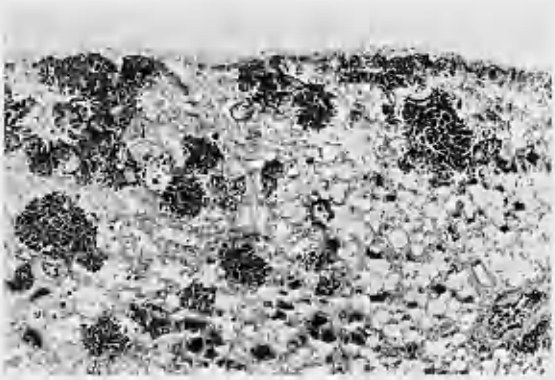

FIG. 7.—From the upper part of the lobe illustrating the multiple nodular distribution of the tumour where involvement of the lung is early. Blood is present in some of the alveoli, presumably the result of operative trauma. H. and E. (× 9.)

breath, and the expectoration of large quantities of frothy sputum. X-ray examination two months after her discharge from hospital (*Fig.* 8) revealed involvement of the remaining portion of the right lung and also small

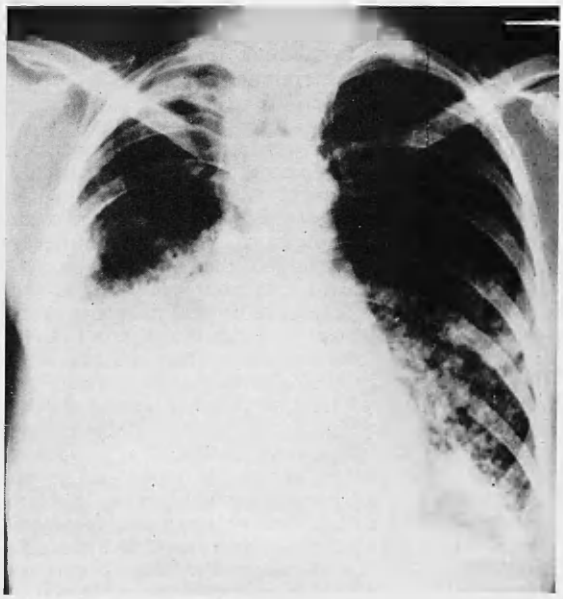

FIG. 8.—Radiograph taken two months after operation, showing spread of the disease in right upper lobe and to left lung. The discrete character of the lesions is well shown.

areas of opacity in the left lung most numerous towards the base. Her general condition had deteriorated and it became steadily worse as time went on. Cough was extremely troublesome and she died at home six months after operation. A necropsy was not obtained.

DISCUSSION

In presenting this case as one of pulmonary adenomatosis we are conscious that without post-mortem examination to exclude an extrapulmonary site of origin the evidence is incomplete. The anatomical features and the histological characters of the growth are, however, in keeping with the descriptions of pulmonary adenomatosis in the literature, and the absence of evidence of any extra-pulmonary lesion is further support for our belief that the lung was in fact the site of primary origin of the neoplasm. Nevertheless, the multiple nodular character of such growths always demands that consideration should be given to the possibility of spread from an extrapulmonary source, for we have observed examples of secondary pulmonary growths in which the morbid anatomical appearances in the lung resembled closely those of pulmonary adenomatosis. Such an occurrence seems unlikely in the present case when it is recalled that the disease, while extensive in the right lung, was limited to it, so far as could be detected, when the patient first presented; a unilateral distribution would be very improbable in carcinomatosis. Furthermore, the distribution of the disease indicated progressive involvement from the base of the lung to the apex; it was not haphazard, as in blood-borne metastases, and on histological examination of the excised lobe it was clear that the multiple nodules were not the result of dissemination of cancer via the lymphatics. In adenomatosis the multiple nodular character of the growth may, in any case, be accounted for either by seeding within the lung or by the growth being multifocal in origin.

In considering sites of primary origin of cancer from which spread to the lung might have produced histological appearances similar to those found in the case under discussion, the two chief possibilities are ovary and thyroid. Either of these organs could have been the source of a tumour with the papillary structure of this neoplasm while the restricted invasiveness and general absence of cytological evidence of malignancy of the growth would fit particularly well a neoplasm originating primarily in the thyroid on the analogy of the benign metastasizing goitre; but the lung tumour produced mucin and as this is not a feature of thyroid neoplasms it is probably sufficient to exclude the thyroid from further consideration as a possible primary site. The fact that the patient showed no sign of a pelvic disorder is only of limited value in excluding the possibility of ovarian cancer, and the account by Nicholson (1909) of a symptomless ovarian cancer which metastasized widely to the lungs and to no other organ outside the pelvis engenders caution lest the possibility be dismissed without adequate consideration, for these metastases used the alveolar walls as their stroma and so produced an appearance strongly resembling the more highly mucin-secreting varieties of adenomatosis. The even distribution of cases between the sexes in the examples of pulmonary adenomatosis recorded in the literature is, however, clearly against confusion with secondary ovarian carcinoma having been a frequent occurrence, and in the present case the histological features of the growth are not strongly suggestive of secondary ovarian carcinoma. The high degree of differentiation and the corresponding lack of invasiveness are not what one would expect to see in such metastases. Furthermore, there was no evidence on histological examination of lymphatic involvement and, as has been said, the pattern of distribution of the tumour in the lung was clearly against blood-borne metastases. In brief, the case described conforms in every particular with accounts of the pathology of pulmonary adenomatosis in the literature (Weissmann, 1934; Sweany, 1935; Bonne, 1939; Dacie and Hoyle, 1942; Sims, 1943; Drymalski, Thompson, and Sweany, 1948) and presents no features which would suggest an alternative diagnosis.

The clinical features and the natural history of this case are also in keeping with the descriptions of pulmonary adenomatosis given in the literature (Jennings, 1948; McCallum, 1949). The illness lasts usually from six months to two years and it is characterized by steady deterioration in the patient's general condition and aggravated by one or more attacks of pneumonia. The production of abundant clear sputum has been a feature in many and is, indeed, the only symptom of any diagnostic value. Hæmoptysis has occurred in only about one-third of the cases. Physical examination of the chest in the early phase may reveal patchy dullness attributable to areas of consolidation which, on X-ray examination, show as small, poorly-defined shadows. With further progress of the disease dullness may involve an entire lobe and further patches may be found in other lobes, as is confirmed by the X-ray appearances where coalescence of shadows may give rise to a picture like that of an atypical pneumonia or of a mycosis. Consolidation of an entire lung may result and ultimately the opposite lung may become similarly involved. (For details of the radiological changes *see* Geever, Carter, Neubuerger, and Schmidt, 1945; Paul and Ritchie, 1946; Kent, 1951.)

Endoscopic examination frequently fails to reveal any abnormality, but sometimes an excess of serous fluid is seen welling up in the bronchus of the affected lobe. The examination is of value, however, in that it excludes the possibility of a bronchial carcinoma in the stem and medium-sized bronchi, and it also provides the opportunity to obtain a sample of the bronchial secretion for cytological examination. The value of sputum examination, which is more frequently employed in the United States than in this country, seems to be considerable. Thus, Good, McDonald, Clagett, and Griffith (1950) report that the cytological findings suggested the diagnosis in 4 out of the 6 cases in which they employed the method. Cytological examination of sputum from the present case was not carried out until one month after operation and then no abnormality of the cellular constituents was detected.

Pulmonary adenomatosis occurs chiefly between the ages of 40 and 60 years, so it is not surprising that cases are frequently mistaken for carcinoma of the lung, especially when the changes are localized to a single area of opacity or to a single lobe. Undoubtedly pulmonary adenomatosis should be considered in any case in which there is abundant, relatively uninfected, clear frothy sputum, and when the X-ray appearances show progressive consolidation in one lobe or multiple small opacities in one or more lobes. Cytological examination of the sputum may be

helpful; it should certainly be done (Griffith, McDonald, and Clagett, 1950).

In many instances the patchy nature of the consolidation has led to the erroneous diagnosis of bronchopneumonia, and when an entire lobe is involved unresolved pneumonia has to be considered. When the disease becomes widespread advanced tuberculosis or carcinomatosis may be suspected.

The treatment of these cases is a difficult problem. From a study of the literature it is apparent that the disease advances fairly rapidly with progressive involvement of the lung substance, death occurring within a period to be reckoned in months rather than years. This is a strong argument in favour of radical excision when the disease is in the early stage and more and more cases are now receiving surgical treatment. Thus, prior to 1943 only 3 of the cases reported had been treated surgically. In recent years with increasing recognition of the condition and the introduction of more active measures in the investigation and treatment of suspicious radiological opacities, as many as 8 cases have been treated at one centre (Good and others, 1950). The difficulty is to detect the early case; only too often the disease does not declare itself until it has advanced beyond the stage at which complete excision is possible. There is, however, another and more fundamental difficulty; it is undecided as yet whether the disease spreads through the lungs by a process of intrapulmonary seeding or whether it is of multifocal origin in the lung tissue. It is, therefore, uncertain whether the disease will ultimately prove amenable to surgical treatment. On reviewing the cases treated surgically it is found that these have been unilateral and apparently free of metastases to the bronchial nodes, i.e., they are of the less malignant type. When both lungs are involved it is obviously impossible to extirpate the disease by surgical measures and in such cases radiotherapy has usually been employed. The total number of cases recognized during life and treated either surgically or by radiotherapy is, however, insufficient to provide a clear indication of the usefulness of these measures in the management of this rare disease.

'Pulmonary adenomatosis', a term originally used in veterinary pathology to describe a morphologically similar disease in sheep (Dungal, 1938), seems a more appropriate name meantime than 'alveolar-cell tumour' (Neubuerger, 1941) for cases of this kind in view of the uncertainty regarding the precise cell type in the lung from which these neoplasms take origin. It may be argued that this designation suggests a benign lesion whereas the condition was malignant, since by its growth and extension it took the patient's life. Histologically the growth would be classified as only locally malignant, the possibility being that more active growth might develop, especially in those areas where the epithelium was mucin-secreting. In the absence of necropsy we are unable to state whether extrapulmonary metastases ultimately developed and so to that extent we lack precise knowledge, but in this disease, unlike bronchial cancer, metastases are not the most frequent cause of death. Septic complications in the lungs are common in both diseases terminally, but whereas pulmonary insufficiency due to extensive involvement of the lung substance by tumour rarely develops in bronchial cancer, it is common in pulmonary adenomatosis, which frequently kills by the progressive involvement of more and more lung tissue until eventually too little is left to sustain life. Such behaviour is not incompatible with the designation 'adenomatosis'.

SUMMARY

The clinical and pathological features are described of the first case of pulmonary adenomatosis to be recorded in this country, in which the diagnosis was made before death. The only symptom of diagnostic value was the expectoration of abundant frothy sputum.

The disease was present in the lobectomy specimen in the form of multiple nodules which had coalesced to produce almost uniform involvement of the lower and medial part of the lobe. There was no invasion of the pleura and microscopical examination disclosed a highly differentiated epithelial neoplasm of pronounced papillary architecture and only very restricted powers of replacing the normal lung structures. Mucin formation was not a pronounced feature of the growth.

After operation the remaining portion of the right lung became involved and the disease spread also to the left lung. The patient became progressively more dyspnœic and died at home six months after operation. A necropsy was not obtained.

The differential diagnosis is discussed from both clinical and pathological aspects, and mention is made of the features of the disease which render the designation 'pulmonary adenomatosis' appropriate to such cases.

We wish to express our thanks to Mr. Bruce M. Dick for permission to publish this case and to Mr. W. Penny, F.I.M.L.T., for his work in the preparation of the histological sections.

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SIMPLE TUMOURS.

Case No.1.

G.MacP. (36), Occupation - Engineer.

Admitted 21.2.49,

Dismissed 15.3.49.

Diagnosis. Neurofibroma of posterior mediastinum.

History. In November 1945, he began to complain of pain which started in the right side of his spine about the 5th thoracic vertebra. This pain radiated round the chest and ended by spreading upwards and downwards over the sternum and epigastrium. The pain came on at rest and was not brought on by exertion or deep breathing. It did not radiate down his right arm. His own doctor treated him as a case of intercostal neuritis, without effect. He was finally sent to Dr. J. Wright, who investigated his case and diagnosed the presence in the chest of a neurofibroma. He had had no cough, no breathlessness, no hoarseness or other symptom, and he had not lost weight. The pain gradually decreased in intensity and eventually disappeared for three years apart from an occasional twinge of pain. On 2.1.49, the pain returned suddenly while he was at rest. His own doctor sent him to the Western Infirmary where he had a novocain infiltration which alleviated his pain to some extent. He was then X-rayed and his admission

to Hairmyres was arranged. He had never noticed any subcutaneous swellings on his body.

Examination. He looked fairly well although slightly pale and nervous. There were no enlarged palpable glands , no cyanosis and no clubbing of the fingers. No subcutaneous swellings were found.

Respiratory System. Examination revealed that the percussion note was resonant throughout. The respiratory murmur was vesicular and no adventitious sounds were heard.

Alimentary system
Cardio-vascular system,
Genito-urinary system. } showed no abnormality.

21.2.49. X-ray Report, Dr. McKail. "There is an ovoid opacity of homogeneous density approximately 3 x 4 cms. in the posterior mediastinum to the left of the 5th dorsal vertebra. The margins of the swelling are well defined, and there are no bony changes.

The appearances are probably due to neurofibroma or ganglioneuroma".

24.2.49. X-ray Report, Dr. McKail. "Oblique views of the spine show no abnormality in the intervertebral foramina".

25.2.49. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Cyclopropane.

The chest was opened through the 4th left interspace using the postero-lateral incision. The 4th rib was divided posteriorly. There were no adhesions between the lung and the chest wall, and the tumour mass was immediately seen in the paravertebral gutter about the level of the 5th thoracic vertebra lying extra-pleurally. The tumour was lying just medial to the descending aorta. The pleura was incised and the mass was easily removed. It did not appear to be adherent to any of the surrounding structures. The pleural incision was closed, as was the chest wound, an intercostal drain being left in place. 50,000 units of penicillin were instilled into the chest.

Pathological Report, Mr. K. Fraser.

"This is an oval partly lobullated greyish white tumour measuring 3.3 x 2.5 cms. in size. When cut across, the tumour has a similar colour and has a strand-like arrangement. The tumour is completely encapsulated."

1.3.49. Royal College of Physicians Report, No.6576/1172, Dr. Wallace Parke.

"1. A fibrotic tumour with a fasiculate and partly whorled structure.

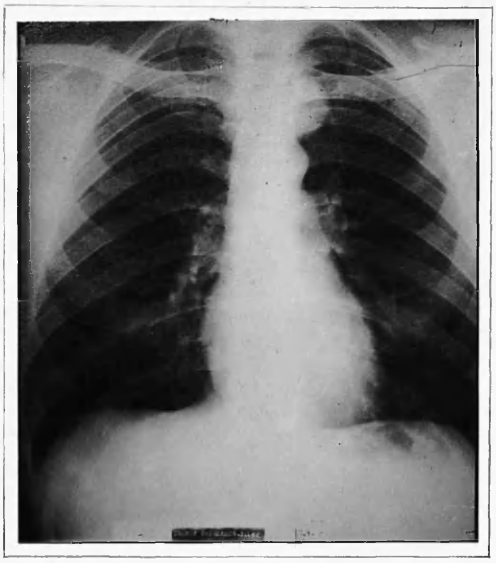
2. Some areas show a tendency to a palisade

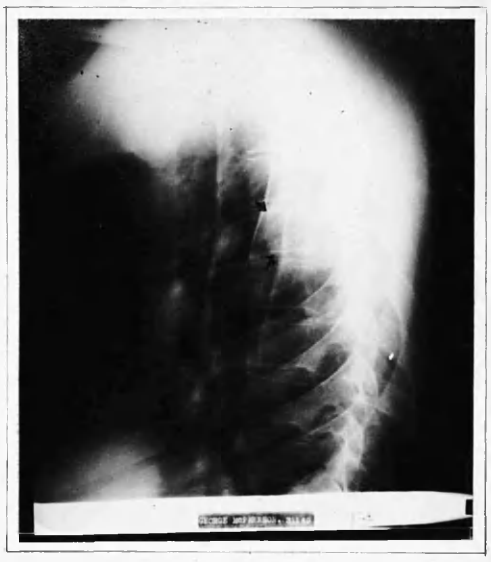
arrangement and there are occasional microcystic spaces.

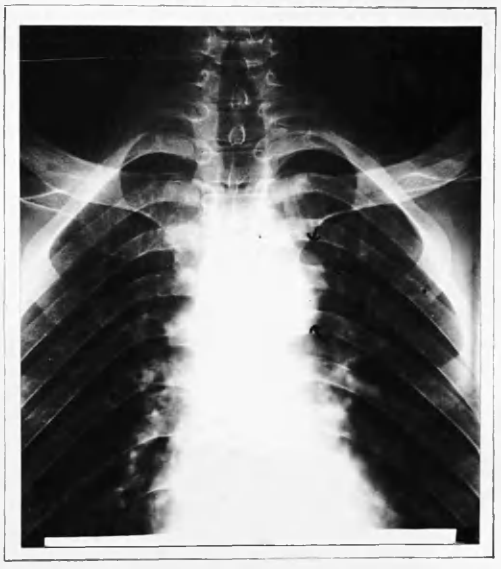
3. Though the histological picture is not absolutely typical there is little doubt that this is a neural tumour - a neurilemmoma, not malignant".

23.2.49. His convalescence progressed satisfactorily and the tube was removed.

15.3.49. He was discharged to-day. He was well.







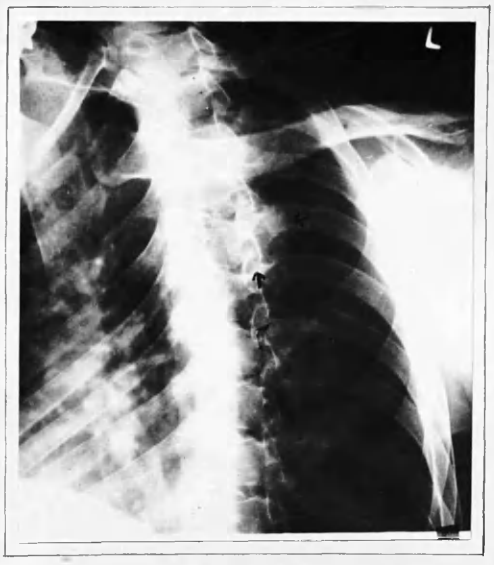
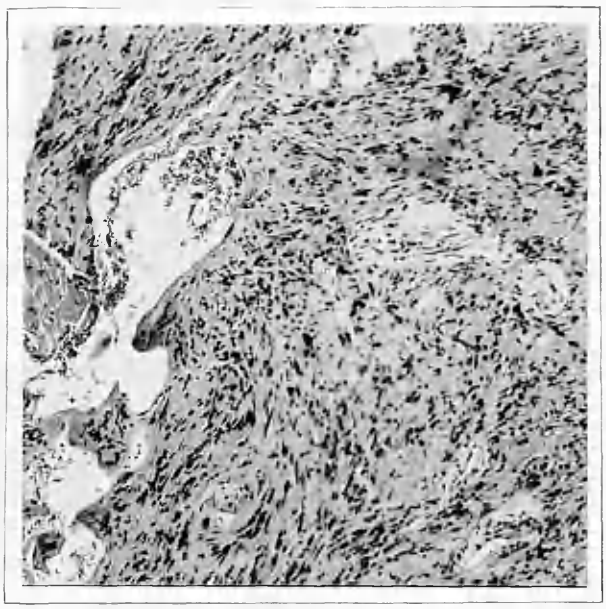


Fig. No.1. A neurofibroma at the side of the 5th dorsal vertebra. This site is unusually low in the thorax for neurofibroma.



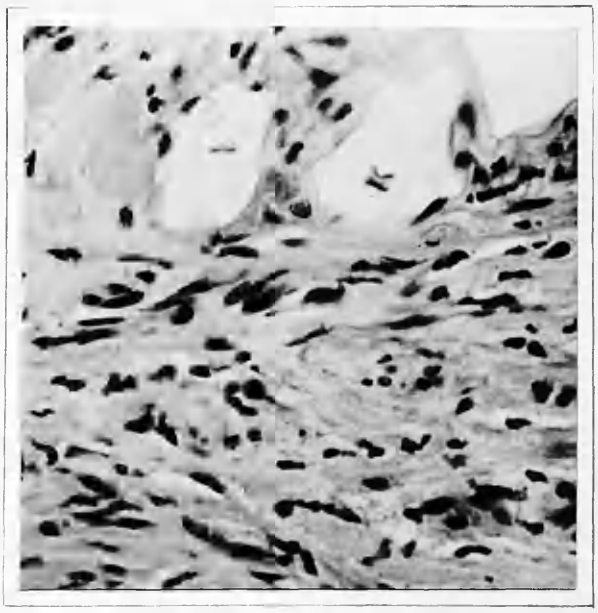


Fig. No. 2. Low and high power microphotographs of the tumour. Note the cystic spaces.

Case No.2.

D.McK. (5).

Admitted 21.9.49,

Dismissed 17.10.49.

Diagnosis Ganglioneuroma.

History. In June of this year, he had what was diagnosed as congestion of the lungs. He was kept under observation for a month and then referred to Paisley for an x-ray examination which showed the presence of a large cystic mass in the left side of his chest. He recovered from this acute illness and he now had no cough, no spit and no discomfort in his chest, nor had he any breathlessness. His previous health had been good.

Examination. Examination showed him to be a bright, lively child, with no apparent restriction of his exercise tolerance.

Respiratory system. The upper part of the left chest showed impairment of the percussion note and diminution of the respiratory murmur and vocal resonance. No adventitiae were heard. The trachea was deviated to the right.

Cardio-vascular system. Apart from re-duplication

of the first sound and systolic bruit, no abnormality was found.

Alimentary system
Central nervous system
Genito-urinary system
} showed no abnormality.

22.9.49. X-ray Report, Dr. Dempster. "There is increase in the A.P. diameter of the chest and widening of the intercostal spaces due to emphysema. A large soft tissue mass is noted in the upper half of the left thorax extending down to the level of the 9th left rib posteriorly. Its anterior and inferior borders are well defined and smooth and the appearances are suggestive of a dermoid cyst".

30.9.49. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton - Pentothal, Cyclopropane.

The left side of the chest was opened through the bed of the resected 5th rib. The upper two thirds of the hemithorax was filled by a large solid tumour which obscured the lung. This mass lay in contact with the posterior chest wall and was covered with parietal pleura. It extended from the apex to the 7th dorsal vertebra and was displacing the aorta medially. It was

not adherent to lung, which was compressed into the lower part of the chest with the left upper lobe being completely atelectatic. The pleura covering the tumour was opened and the tumour mass was gradually enucleated. It was found to have few connections except vascular supply. The upper two intervertebral foramina showed widening, as did the third, and into the latter there extended a prolongation of tumour tissue from the main mass. The tumour was removed intact and haemostasis was secured in the area of its removal. A portion of oxycel gauze was placed over an area of oozing in the raw surface from which the tumour had been removed. The lung was then inflated and the upper lobe was found to aerate satisfactorily with the exception of the axillary division of the pectoral segment which did not re-expand. The chest was closed after a drain had been inserted and penicillin instilled.

The Specimen. Mr. Fraser. "The tumour is a solid encapsulated oval mass weighing 15¼ ounces, greyish white in colour. On section it showed a similar

colour and a whorled effect on its surface.
The appearances are consistent with a nerve tumour".
Histological Report, Royal College of Physicians Laboratory, No.102/4967, Dr. Lees. "This is a ganglioneuroma. It shows a well developed structure with scattered (sometimes in little masses) well formed, ganglion cells lying in a neurolaminatoid matrix. This latter is formed of spindle shaped, thin inactive looking cells. There is nothing here to indicate a malignant type of growth".

1.10.49. He was a little upset by the operation although in the evening he showed a left Horner's syndrome. The x-ray of the chest showed the lung to be completely expanded.

4.10.49. The drainage tube was removed. The Horner's syndrome was persisting.

8.10.49. The child was very well.

17.10.49. The child was dismissed home.

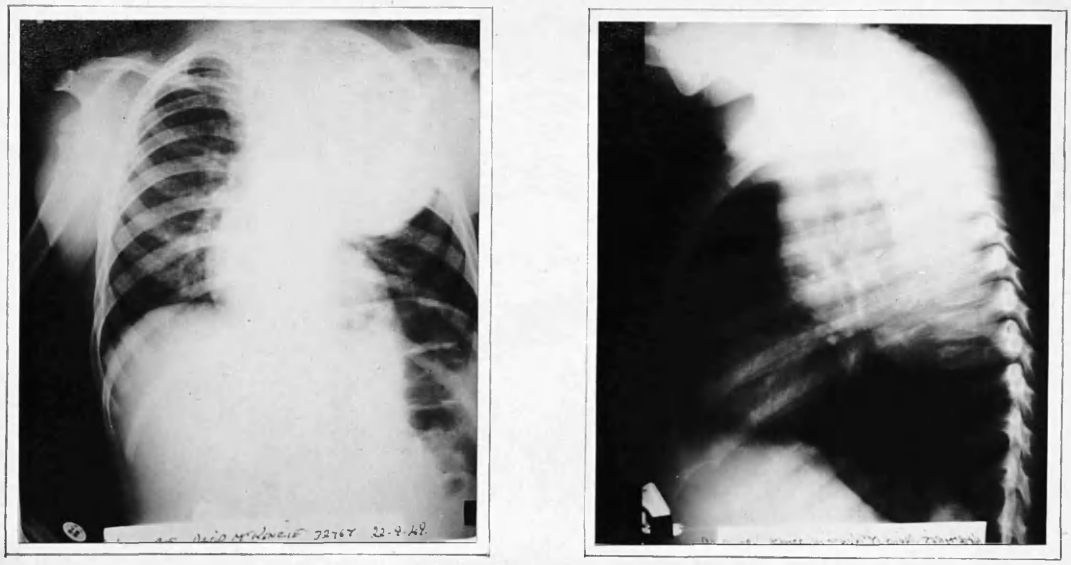


Fig. 3. A large ganglioneuroma in typical site: apical and posterior. The tumour shows characteristic density with clean cut edge.

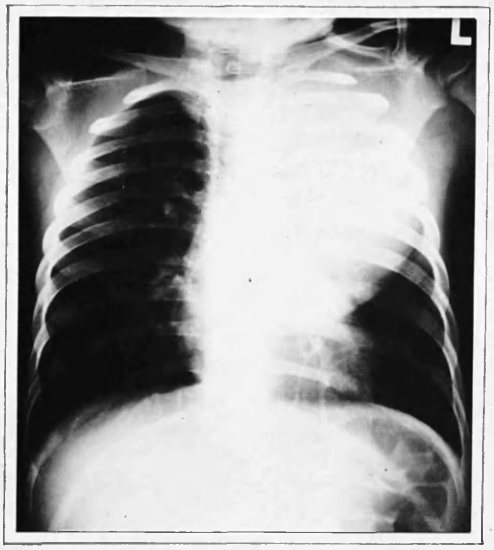


Fig. 4. A 'penetrated' x-ray film shows the tumour to extend in a distal direction to the posterior end of the ninth rib.

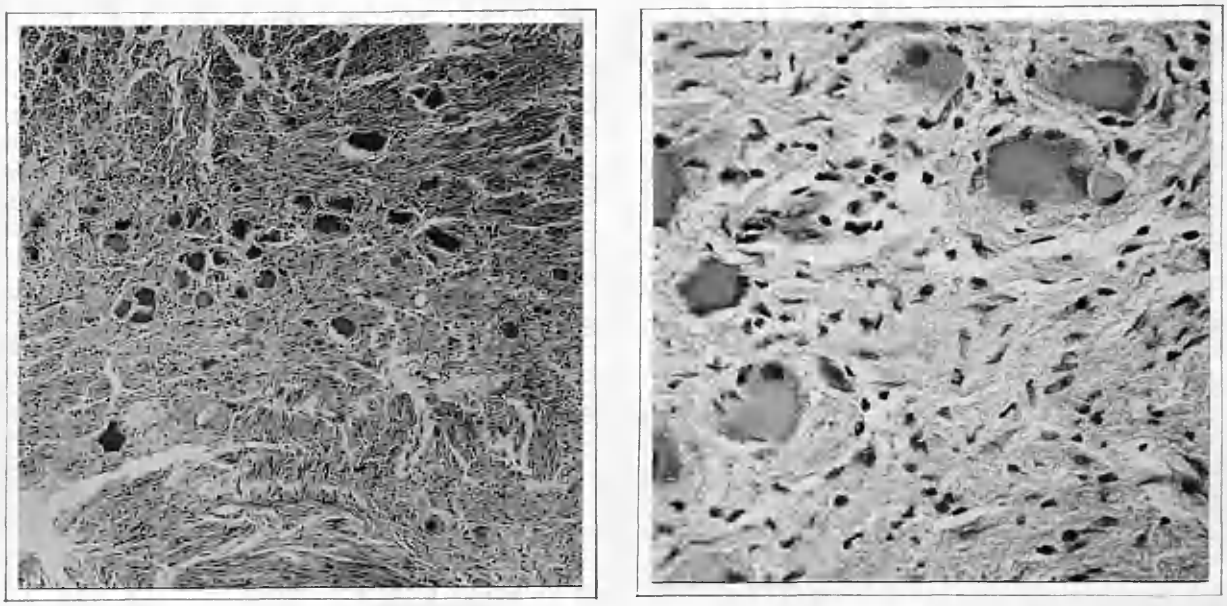


Fig. 5. A representative area to illustrate the ganglion cells and general histological pattern.

Case No. 3.

W.C. (17). Occupation - Bank Clerk.

Admitted 7.2.43,

Dismissed 13.2.43.

Diagnosis Ganglioneuroma.

History. When he was about 11 or 12 years of age he was examined by a school doctor who found "something" abnormal in his right chest. This "something" was presumably dullness. He was x-rayed at that time but did not know the result of that examination. His attention being thus drawn to the right side of his chest he began to experience a heavy sensation on the left side and he also began to feel easily tired. This had not become worse, but when he entered the service of the bank he required to undergo an examination and this was carried out six weeks before admission. At the examination he was advised to see Mr. Dick. On the right side of his chest he had noticed a lump posteriorly especially obvious on bending forward and he had been aware of this since the examination by the school doctor. He had had no cough or spit and he had never had a haemoptysis. He had had no breathlessness. His appetite was

good, and he had been putting on weight. He had been playing rugby for Madras College as scrum half and he was considered to be a good player.

Previous Health. Measles; tonsillitis and whooping cough.

Family History. One brother and one sister were both alive and well, as were his father and mother.

General Examination. He was well nourished and showed no cyanosis, jaundice or oedema. His skin was well coloured and he tended towards hirsutes. There was no clubbing of the fingers.

Respiratory System. There was a prominence of the spine - a gibbus - about the level of the 10th/12th dorsal vertebrae. There was also a scoliosis of moderate degree convex to the right, with some flaring out of the right lower ribs posteriorly. There was no tenderness over his spine or over the swelling. The percussion note was dull and the respiratory murmur, vocal fremitus and vocal resonance were diminished and practically absent. No adventitiae were heard.

His weight was 9st. 11b. Other systems showed no abnormality.

Blood Examination. Haemoglobin 95%, R.B.C. 4,870,000, W.B.C. 7,400.

Differential count showed no gross abnormality.

8.2.43. X-ray Report, Dr. Hurrell. "There is a mass below the right side of the diaphragm pushing it up to the 6th dorsal vertebrae and also spreading across the diaphragm down to the left at the left of lumbar vertebra 2. It is pushing back between the heads of the 11th and 12th right ribs. The 11th is luxated upwards; the 12th appears to have been fractured. Calcification is seen in the middle of the mass and dorsal vertebrae 10, 11 and 12 show erosion which reaches the lamina of 11th and 12th and has caused partial collapse. The bone changes suggest low grade malignancy, possibly teratoma".

11.2.43. Lipiodol examination shows that the mass has displaced the lung.

13.2.43. The patient was sent home and was to return for operation.

1.4.43. Re-admitted.

13.4.43. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Gas, Oxygen,
Trilene.

The chest was opened with the usual postero-lateral incision. A large tumour was seen filling almost the whole of the right side of the chest. The tumour was adherent to the diaphragm, the mediastinum and the spine. The right lung was largely collapsed, due to the space occupying size of the tumour. The tumour lay posteriorly and was removed in lobes with great difficulty and during its removal long strands of nerve like tissue became strung out. At one stage in the course of the operation it was almost decided that the tumour was too adherent for safe removal, but with care a line of cleavage was found and most of the tumour was removed although some small portions were left still attached to ribs at one point. The wound was closed.

During and after the operation the patient was given two pints of blood and two pints of plasma. Pathological Report, Dr. Taylor. "The cut surface of the tumour was firm and smooth and showed a fasciculated yellow "watersilk" appearance.

Histologically the tumour showed a moderate number of large cells with a clear cytoplasm having one or more nuclei, with distinct nucleoli scattered throughout a matrix of loose cellular fibrous tissue, along with smaller rounded cells and numerous blood vessels. This is a ganglioneuroma".

Progress. The patient died early in the morning following operation.

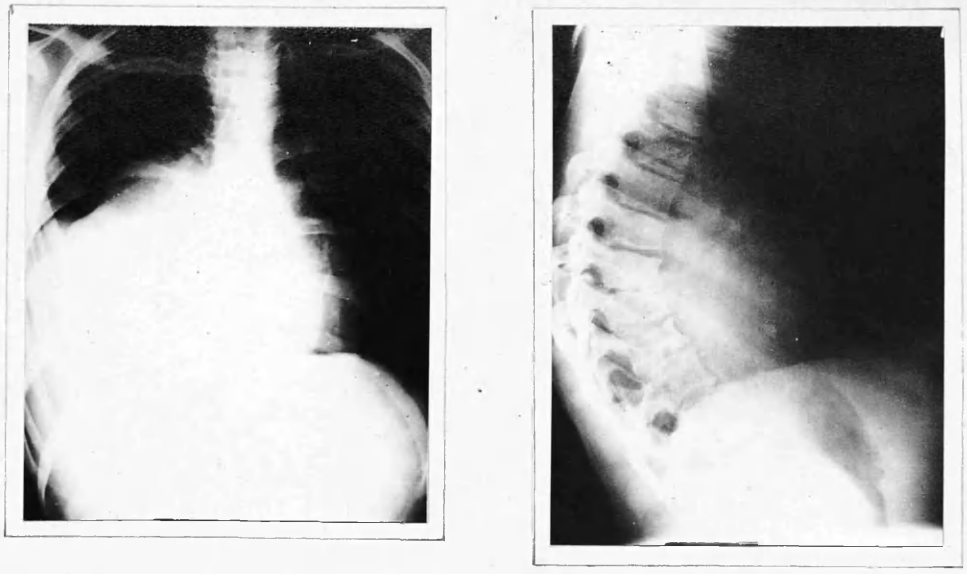


Fig. 6. The extensive dense shadow occupying lower half of right chest is due to a ganglioneuroma. The lateral view shows a marked kyphosis of spine at the site of the tumour shadow. There is erosion of the 10th, 11th and 12th dorsal vertebrae.

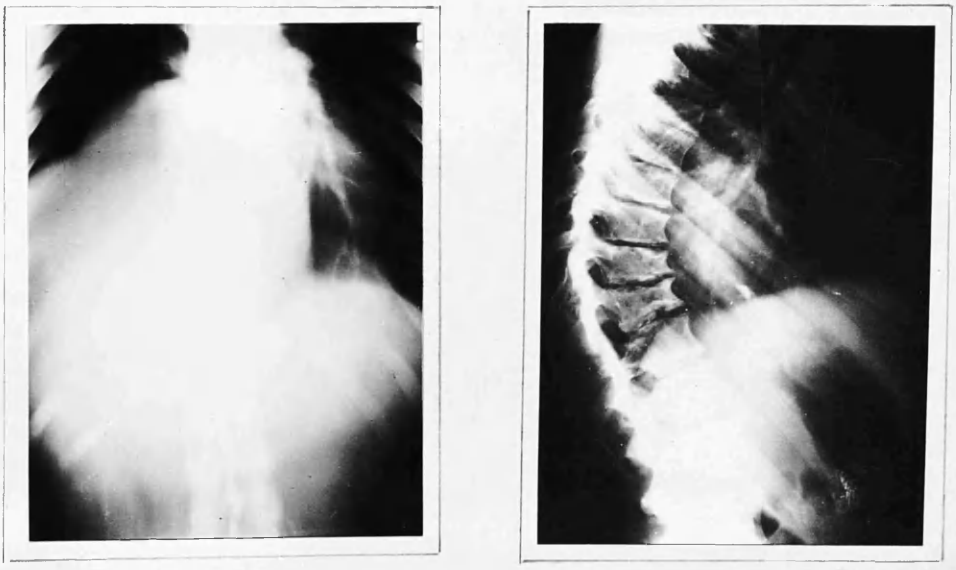


Fig. 7. Tomograph film reveals the lobulated character of the tumour. This lateral x-ray film shows more penetration and reveals the erosion and decalcification of the 10th, 11th and 12th dorsal vertebrae, their pedicles and part of their laminae. There is partial collapse of the three vertebrae.

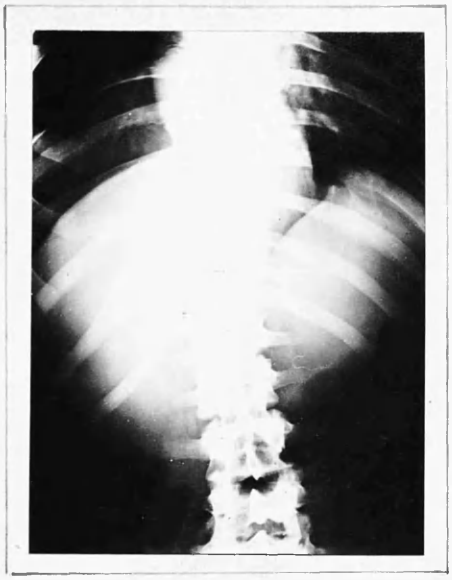


Fig. 8. Penetrated x-ray film. This shows what looks like a raised right diaphragm but which is in fact a massive ganglioneuroma above the diaphragm. The scoliosis can also be seen. Note the upward displacement of the posterior end of the 11th right rib.

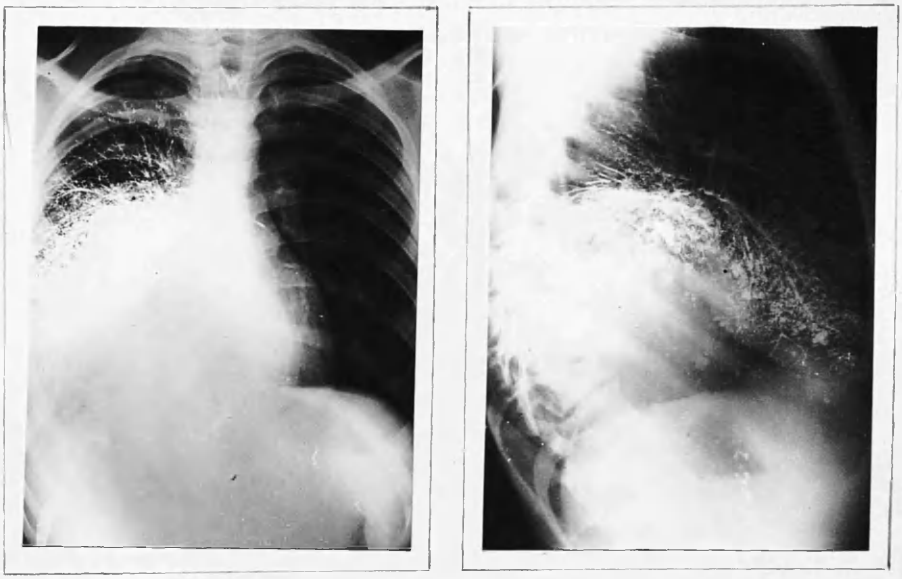


Fig. 9. Right bronchogram outlines the right lower lobe compressed and pushed upwards into mid thorax by the tumour. The lateral film shows the outline of the middle lobe bronchus with medial and lateral divisions more or less normal but with a "drooping willow" effect due to upward displacement of the stem bronchus.

Fig.10. Outer aspect of a lobule removed at operation. The lobulation is well seen.

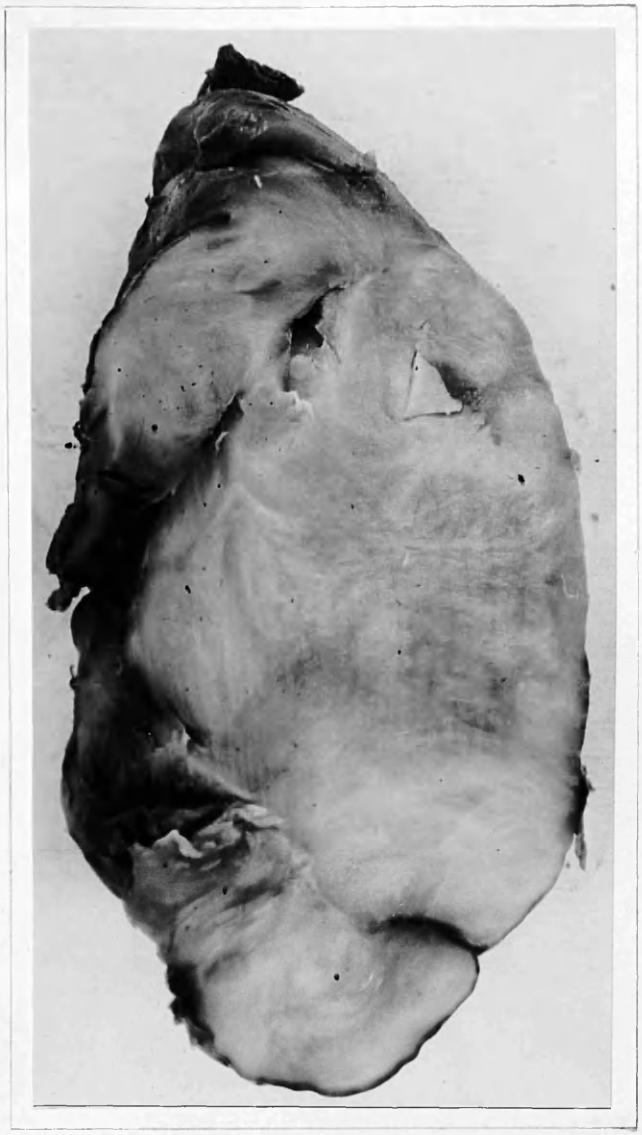


Fig. 11. Cross section of one of the removed lobules of the ganglioneuroma; this too is lobulated and shows a striated appearance.

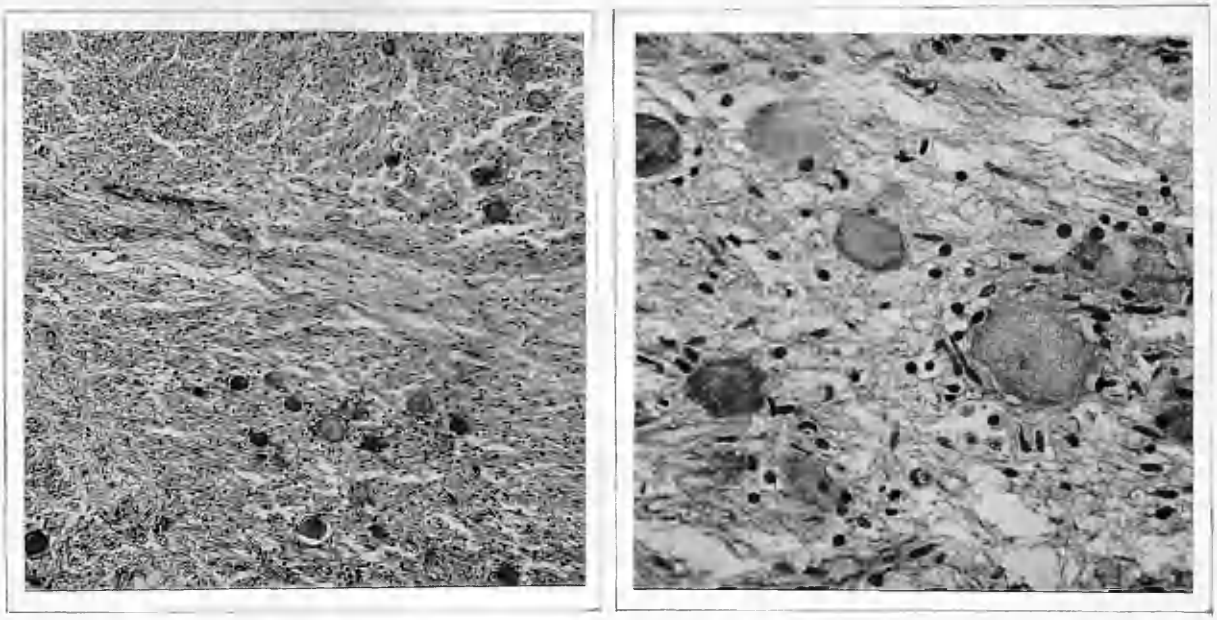


Fig. 12. A representative area to show the general histological picture. Many cystic spaces are seen.

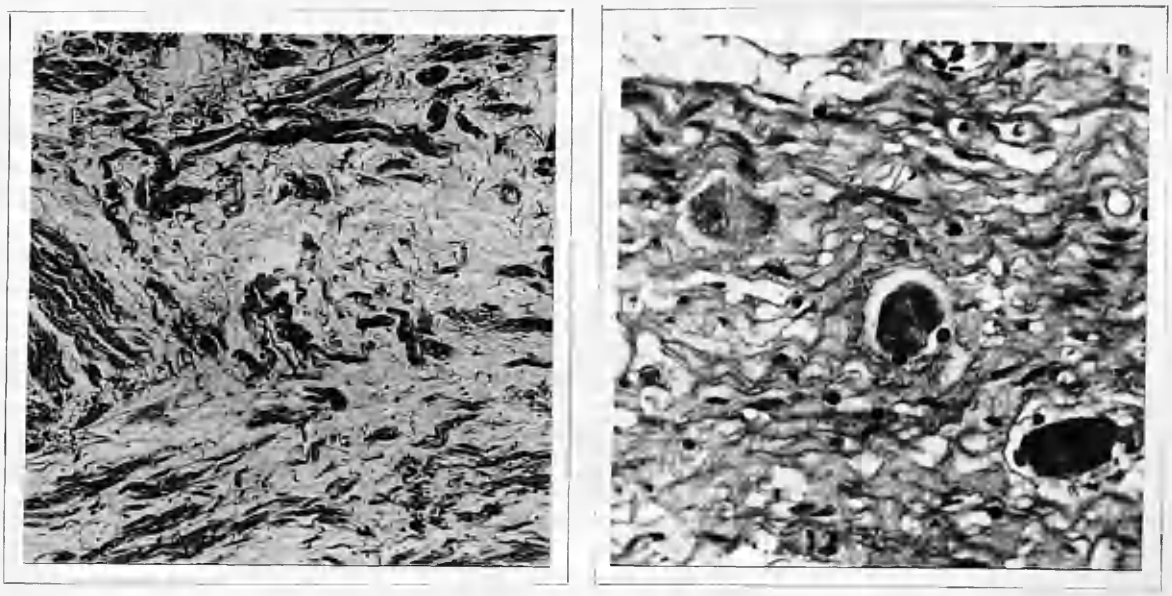


Fig. 13. Sections stained to show the fibrous tissue.

Case No. 4.

A.S. (39). Occupation - Clerkess.

Admitted 7.5.51,

Dismissed 9.6.51.

Diagnosis Intrathoracic Neurofibroma.

History. While she was undergoing routine examination prior to her departure to Canada a mass was found in her right chest. She had had no complaints until she was told that there was something wrong within her chest when she began to feel some tightness of her chest.

Examination. She was a healthy looking female.

Respiratory system. There was an area of dullness below the right clavicle, otherwise no abnormality was detected.

9.5.51. X-ray Report, Dr. Munro. "There is a well defined roughly spherical mass in the right upper lobe, probably a benign tumour. Nature doubtful".

11.5.51. Theatre, Mr. Dick, Mr. Fraser. Dr Pinkerton
Pentothal,
Cyclopropane,
Tubarine,
G. & O_2.

With the patient in the lateral position the right chest was opened through the bed of a resected rib. The lung was adherent to the tumour but not attached to the chest wall. The tumour was in the apex of the

thorax and was the size of an apple, firm in consistency, encapsulated and attached by a narrow pedicle to the middle of the 1st rib. The pedicle was ligated and the tumour was removed. The chest was closed in the usual way.

14.5.51. Pathology Report, Royal College of Physicians, Dr. McGregor. "A fibroma (possibly of neural origin, i.e. a neurilemmoma). It is formed by interlacing cords of collagenous tissue. The cords are made up by groups of thick collagenous fibres between which lie cells with elongated flattened nuclei. These fibroblastic cells show few if any mitotic figures. The tumour contains numerous large vascular spaces with thin walls. The tumour may originally have been associated with the sheath of a nerve, i.e. neurofibroma or neurilemmoma. Now, however, the fibres between the cells are so collagenous in type that it is difficult to be certain of the type of tumour. There is no malignancy".

9.6.51. She made a good recovery and was dismissed.

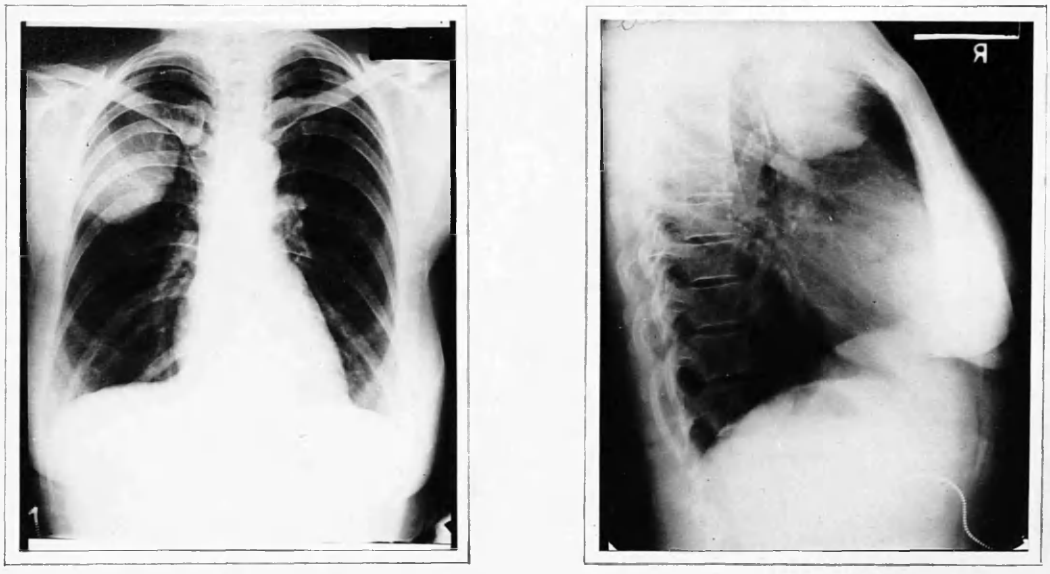


Fig. 14. A neurofibroma in the unusual lateral and infraclavicular situation.

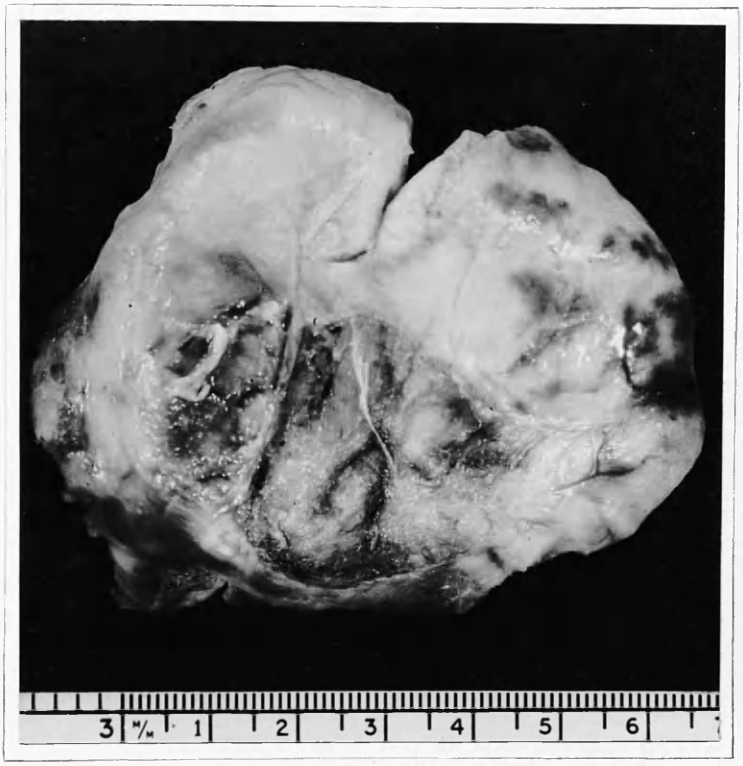


Fig. 15. The specimen. It was attached by a narrow pedicle to the middle of the first rib.

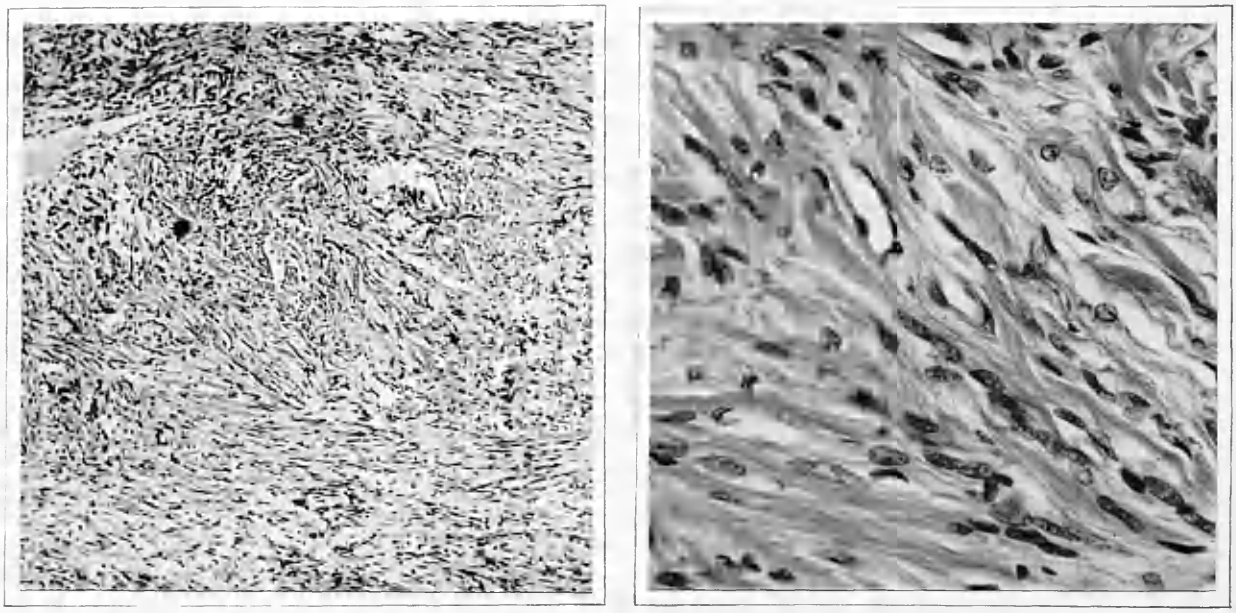


Fig. 16. The typical interlacing arrangement of the fibres and the spindle shaped cells.

Case No. 5.

T.C. (25). Occupation - Soldier.

Admitted 31.7.44,

Dismissed 4.8.44.

Diagnosis Ganglioneuroma of posterior mediastinum.

History. This patient was found on mass radiography to have a shadow in the upper left posterior mediastinum. He had had no symptoms and did not know when the condition started.

Previous Health. He had had measles, whooping cough and scarlet fever in childhood. He had not had rheumatic fever, pneumonia or pleurisy and had not been subjected to colds.

Family History. His mother died in February 1944, of left heart failure. His father was alive and well as were also all his brothers and sisters.

Examination. He was a well built man of asthenic type. There was no oedema, no enlarged glands and no clubbing of the fingers.

Respiratory system. There was bulging in the left apical and subscapular regions. The chest moved freely and equally on respiration. Percussion note was impaired in the left upper anterior and

and posterior zones. No vocal fremitus was felt and in the left upper zone the respiratory murmur was vesiculated but diminished, as was the vocal resonance. Other systems showed no abnormality.

Blood count. Haemoglobin 100%, R.B.C. 4,940,000, W.B.C. 6,300.

Differential count showed no gross abnormality.

2.8.44. 800 ccs. of air were induced into the left pleural cavity and the patient was X-rayed.

3.8.44. X-ray Report, Dr. McKail. "Ovoid homogeneous mass 17 x 12 cms. in the upper left posterior mediastinum with a well defined edge. A portion has turned through the posterior end of the fourth intercostal space. Erosion of the lower margin of the left pedical of the fourth dorsal vertebra suggests intervention into the spinal canal. His pneumothorax shows the tumour free from the lateral chest wall.

This picture suggests a benign tumour of dumb-bell type - neurofibroma".

4.8.44. Operation - Mr. Dick. Dr. Pinkerton - Cyclopropane, Sodium Pentothal.

Dorsal incision made on the left side and the chest was opened in the 5th interspace, ribs 5 and 6

being retracted. The tumour was found to be extra-pleural. The pleura was stripped off the tumour, which was felt to arise from an intervertebral foramen. The tumour was freed and detached from the vertebra, and in doing so a markedly enlarged foramen was found and packed with gauze. The pleura was stitched over the foramen and a drain was inserted. The wound was closed. During the operation two pints of blood were given intravenously.

Pathological Report, Dr. Taylor. "A flesh-like mass 2" x 2" x ½" of the consistency of soft rubber which cut easily to leave a white smooth surface. The picture is not unlike what may be seen in sections of the posterior part of the spinal cord, which consists partly of medullated nerve and partly of columns of fibrous tissue of neurilemmal type. The medullated nerves are gathered into nerve bundles complete with perineurium. These bundles also contain non-medullated fibres and an occasional large ganglion cell with prominent nucleus and nucleolus. The bulk of the tumour tissue seems to have developed from the nerve sheath, the nerves being grouped in one area. Although many of the nerves are spindle shaped, the tissue does not suggest sarcoma,

and there is not a sufficient number of ganglion cells in it to justify the term "ganglioneuroma". It appears as if a neurinoma had developed from and finally included one or more posterior nerve roots.

Progress. The patient was slowly recovering from the operation when he suddenly fell back and died immediately, presumably from haemorrhage.

Footnote. Obviously if the tumour shows any ganglion cells it is a ganglioneuroma.

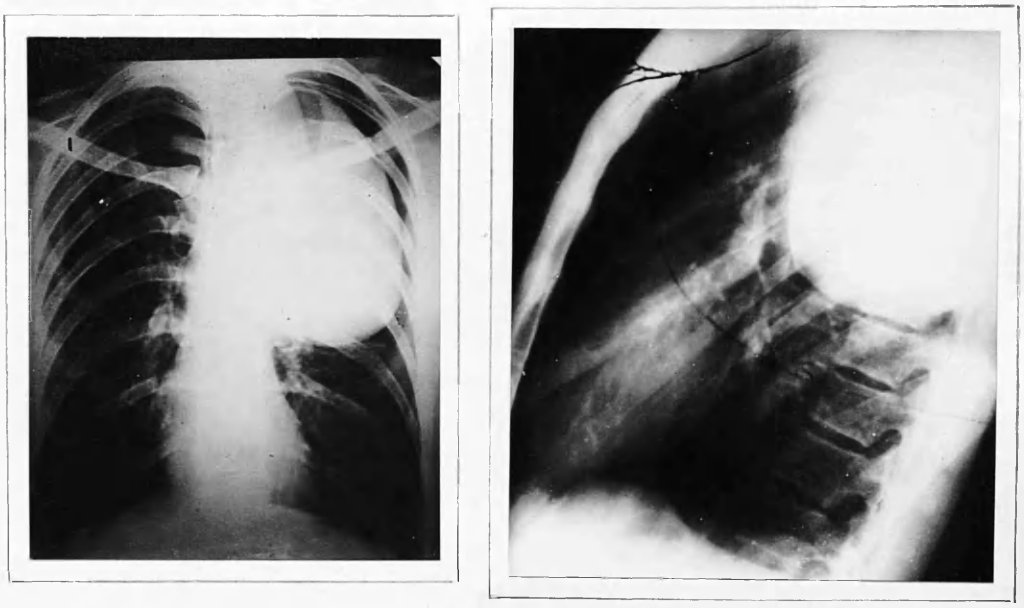


Fig. 17. Typical dense rounded shadow in the posterior aspect of the left chest due to a ganglioneuroma. In the postero-anterior film an artificial pneumothorax has been induced hence the translucent area above the tumour; the latter has dropped downwards from the apex.

Case No. 6.

J.W. (13). Occupation - Schoolboy.

Admitted 8.9.49,

Dismissed 5.10.49.

Diagnosis Ganglioneuroma of posterior mediastinum.

History. In July 1948, he was admitted to Falkirk Infirmary with headache and dizziness accompanied by sickness. These symptoms disappeared in a few days time. During his stay in hospital his chest was x-rayed and a large left sided mediastinal mass was seen. He was kept under observation for the succeeding twelve months and the mass showed no appreciable change in size or appearance. His general health had been good and he had had no breathlessness, pain in his chest, or difficulty in swallowing.

Previous Health. His appendix was removed in 1947.

Examination. He was a well nourished fresh complexioned boy. The neck veins were not congested. The lymph glands were not palpable.

Respiratory system. The chest was symmetrical, resonant to percussion; the respiratory

murmur was broncho-vesicular over the right upper chest towards the mid-line and the vocal resonance was relatively increased. No adventitiae were heard.

Central nervous system, alimentary system and genito-urinary system showed no abnormality.

Blood examination. Haemoglobin 85%, Red blood cells 4,250,000.

9.9.49. X-ray Report, Dr. Dempster. "An opacity (large) is seen in the upper left posterior mediastinum. It has a well defined lateral margin and seems to taper below into the line of the spine. The trachea is not displaced; otherwise lung fields and mediastinum are negative.

Further examinations will be required for elucidation of this case. ?Ganglioneuroma. ?Dermoid cyst".

12.9.49. X-ray Report, Dr. Dempster. "The dorsal spine shows no abnormality".

16.9.49. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton - Pentothal, Cyclopropane.

The chest was opened by a left postero-lateral incision. The lung was free

of adhesions and immediately the tumour mass was seen. The tumour lay beneath the parietal pleura in the paravertebral gutter and was in contact with vertebral bodies of the 2nd, 3rd and 4th thoracic vertebrae. It had a prolongation down on to the commencement of the descending thoracic aorta. The pleura was incised over the tumour and the tumour was dissected out from the aorta and the vertebral bodies. Two prolongations were found to enter the intervertebral foramina between the 2nd and 3rd and 3rd and 4th thoracic vertebrae. The prolongation between 2nd and 3rd thoracic vertebrae was removed completely, but the inferior prolongation was ligated and divided and could not be completely removed. A small piece of tumour tissue had to be left in connection with the root of the first dorsal nerve. An oxycel pack of small size was placed in the bed from which the tumour had been removed and the parietal pleura was then sutured over the pack and penicillin sulphathiazole powder. The chest was closed and 50,000 units of penicillin and a de pezzer catheter were inserted.

19.9.49. The drainage tube was removed. General condition excellent. Lung re-expanded.

20.9.49. Condition very satisfactory. Lung fully re-expanded.

Pathological Report, Mr. K. Fraser. "This is a greyish white tumour 10 x 5 cms. in size. It is kidney shaped. Towards either pole of the tumour there is a lateral extension, one of which entered the 3rd intervertebral foramen and the other had entered the 4th intervertebral foramen. On the medial side a similar pair of prolongations had been present. These had been attached to the aortic arch. On section, the tumour shows a greyish white appearance typical of nerve tumour".

Histological Report, Royal College of Physicians Laboratory, No.9907/4730, Dr. Lees. "This is a ganglioneuroma. It consists of a fibromatoid matrix, has a neurogenic nerve sheath character, and is formed of benign looking spindle shaped cells.

There is nothing histologically to

suggest a specially malignant character, or anything more than a very benign quiescent course for this tumour with its scattered well differentiated ganglion cells".

28.9.49. His general condition was very satisfactory.

17.10.49. He was discharged well.

29.9.49. X-ray Report, Dr. Dempster. "Compared with the film of 22.9.49, there has been further expansion of the left lung and diminution in the left pleural effusion. The upper mediastinum still appears broader than normal. Upper dorsal spine - No definite changes seen in the intervertebral foramina"..

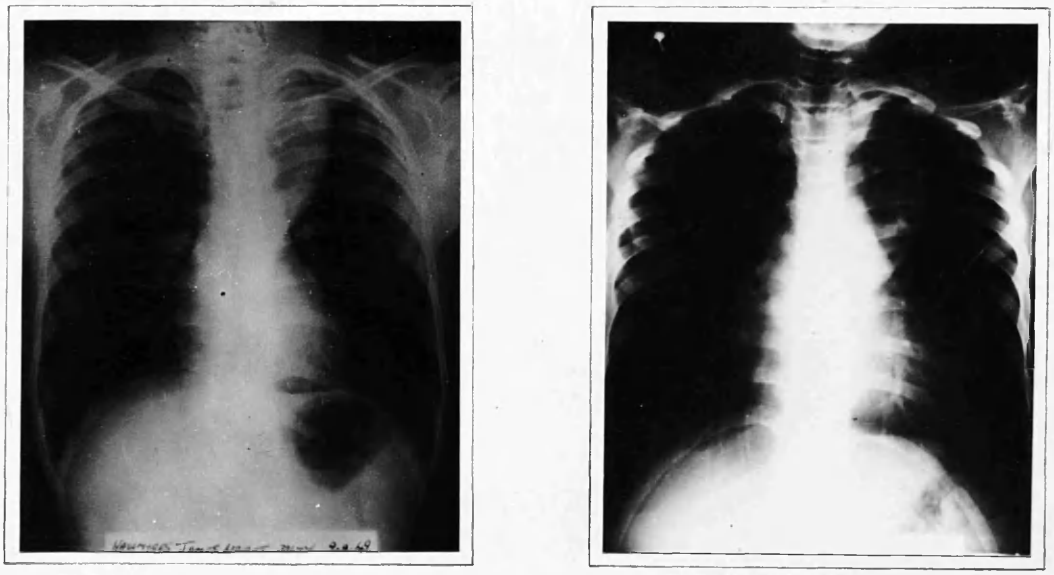
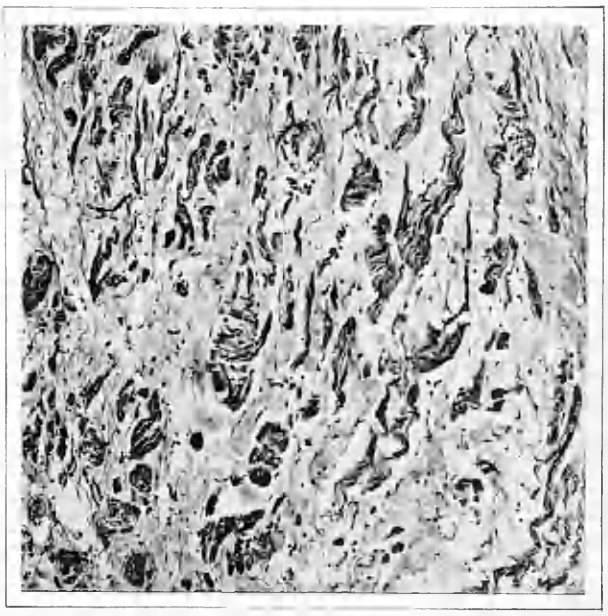


Fig. 18. 10 x 5 cm. ganglioneuroma in the apex of the left chest. The tumour is more elongated than usual. The penetrated x-ray film on the right outlines the tumour faintly but gives a better impression of its large size.



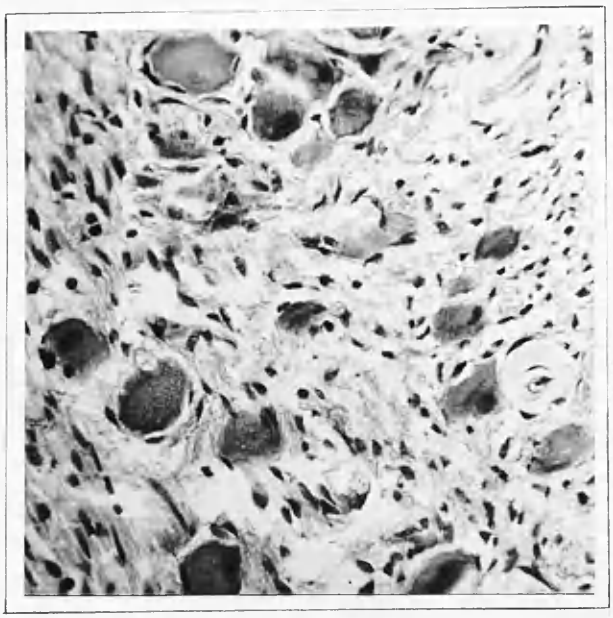


Fig.19. Representative sections of the ganglioneuroma.

Case No.7.

M.K. (48). Occupation - Housewife.

Admitted 22.8.51, 15.11.51,

Dismissed 25.8.51. 26.12.51.

Diagnosis Ganglioneuroma of left side of chest.

History. Two years previously while working in a carpet factory canteen she was routinely X-rayed and found to have a large swelling in the left chest. No treatment was carried out and no investigation. A year later she came to live in this country and was X-rayed at the Royal Alexandra Infirmary, Paisley. She was transferred to the Western Infirmary and at that time she had never complained of pain, cough or dyspnoea nor had had any sputum.

Previous health. She had measles in childhood; otherwise no abnormality.

Examination. She was a heavily built woman of good colour. No dyspnoea or cyanosis and no clubbing of the fingers.

Respiratory system. Chest was symmetrical and there was very little variation in expansion. There was dullness to percussion on the left side of the chest down to the 4th rib, also in the axilla.

The respiratory murmur was inaudible and vocal resonance was reduced. There were no adventitiae.

31.8.51. X-ray Report, Dr. McGregor. "A large well defined mass is evident occupying the upper half of the left chest and lying posteriorly. This tumour is associated with widening of the third left interspace and also with wedge deformity of the 3rd dorsal vertebra. Pedicle of the 3rd lumbar vertebra has also been destroyed and there is widening of the intervertebral foramina. The appearances are consistent with a neurofibroma at the level of the 3rd dorsal vertebra".

30.11.51. Operation - Mr. Dick, Mr. Fraser.

Anaesthetist - Dr. Pinkerton.

Head-down, face-down position. The 4th and 5th ribs were removed in their posterior halves and the posterior end of the 6th rib was divided. A massive tumour was found in the apex of the thorax which was compressing the upper lobe of the lung in a distal direction. The pleura and lung apex were adherent over a small area to the tumour. The pleura was opened into and the lung was freed from the tumour. The tumour was freed by further blunt dissection and was finally left with an attachment into the 4th intervertebral foramen into which a lobule of the tumour extended. This lobule eventually was pulled away and

initially there was a little bleeding from the intervertebral foramen and a continuous trickle of cerebro-spinal fluid. The tumour was lifted out of the chest which was closed with a high posterior drain. The tumour weighed 2lb.12oz.

26.12.51. She had made a good recovery from her operation and was allowed home.

11.1.52. She reported as an outpatient and was well.

4.12.51. Pathology Report, Edinburgh University, Dr. McGregor. "This is a ganglioneuroma showing ganglion cells and nerve fibres probably arising from a thoracic sympathetic chain. The tumour contains scattered ganglion cells of varying size, which are mainly ovoid in shape and have the characteristic large round eccentrically placed nucleus containing a well stained nucleolus. The cytoplasm is basophilic and contains brown pigment granules.

3. The matrix is coarsely fibrillary and consists of quite well formed nerve bundles set in a loose interlacing fibrous tissue.

4. No obvious neuroblastomatous tissue and no mitoses were seen.

Conclusion - This is a well differentiated slow growing nerve cell tumour showing none of the usual criteria of malignancy".

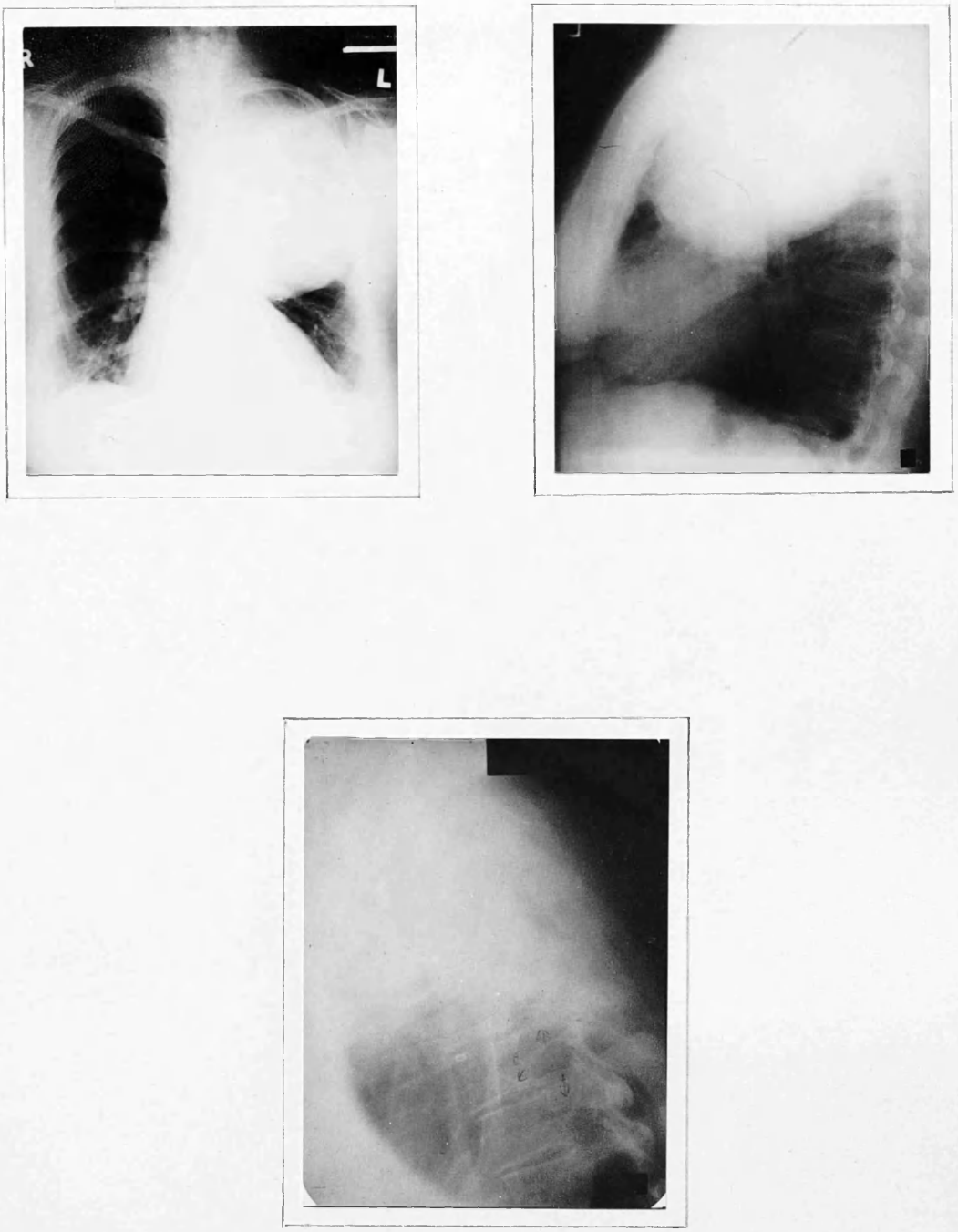


Fig. 20. Typical dense rounded shadow of a neurogenic tumour in the postero-superior aspect of the left chest. When removed the tumour weighed 2lb.12oz. The lower X-ray film shows the marked enlargement of two intervertebral foramina.

Case No. 8.

W.R. (24), Occupation - Electrical Engineer.

Admitted 17.1.49.

Dismissed 31.1.49.

Diagnosis Neurofibroma.

History. For 7 years he had complained of having vague pains in the front of his chest. The pain varied in intensity, at times being dull and aching in character and ill-localised, and at other times being momentarily intense and easily localised. It bore no constant relationship to either exercise or the taking of food, but if he twisted himself at work to an awkward position, the movement brought on the pain. For the year preceding his admission, it had been very severe but had not affected his general health. At one time, 5 years prior to admission, the pains were commanding and severe and he lost a stone in weight. At this time, he was staying in London which was being regularly bombed, and when he returned home his pain subsided and he regained his weight. He had never had cough or haemoptysis and his general health had been good. In June 1948, he was X-rayed and a shadow was reported in his chest.

Previous Health. He had several fevers in childhood.

Examination. He was a well built intelligent man. There was no cyanosis, no distension of veins, no oedema and no clubbing of the fingers.

Respiratory system. The chest moved equally and well. The percussion note was normal. The respiratory murmur was vesicular, except at the right upper zone where it was bronchial in character, over this area there was whispered pectoriloquy and increased vocal resonance. No adventitiae heard.

Cardio-vascular system and alimentary system showed no abnormality.

17.1.49. X-ray Report, Dr. McKail. "There is a rounded mass of homogeneous density occupying the posterior part of the apex of the left hemithorax. Its visible margin is well defined. There is some pressure erosion of the neck of the 2nd left rib.

The appearances are those of an intrathoracic neurofibroma or a ganglioneuroma".

26.1.49. It had been explained to the patient that he had an innocent condition affecting the apex of his left lung and that there was no indication for surgery. He was told that he should be X-rayed regularly every year.

30.1.49. He was discharged.

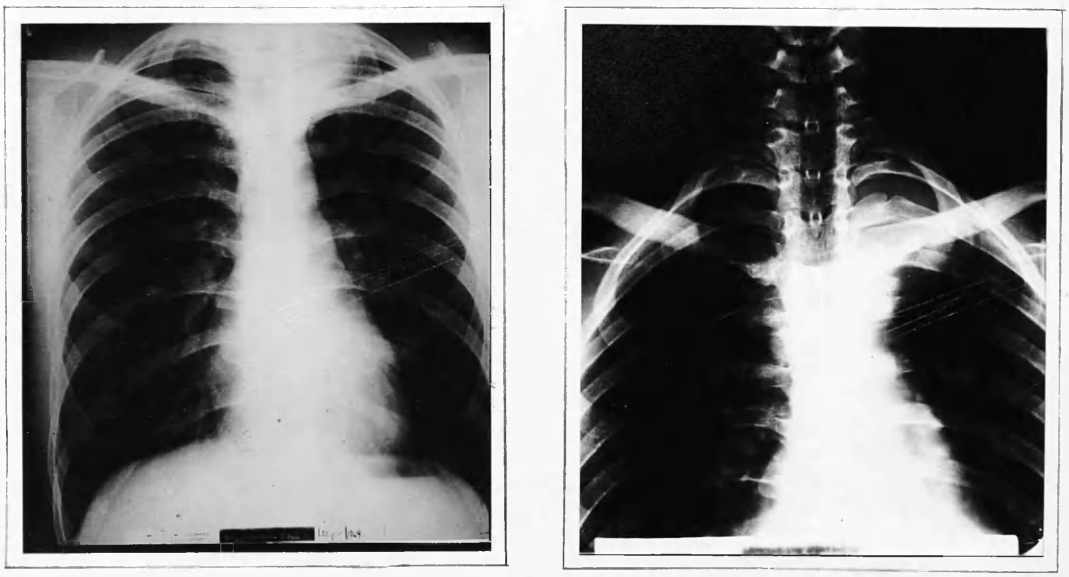


Fig. 21. This case was not operated on but the site and shape of the apical shadow made the diagnosis of nerve tumour practically certain in a male aged 24.

Case No. 9.

A.B. (49),

Admitted 7.6.50.

Died. 28.6.50.

Diagnosis Neurofibroma of posterior mediastinum.

History. Four years prior to admission, the patient had been in hospital for a hysterectomy. Three weeks later, during her convalescence, she developed a sharp pain in the right axilla, which radiated posteriorly. No significant finding was made and the attack subsided. She was later discharged from hospital and remained free from symptoms for three months, when she had a further attack. This improved with rest in bed. Following this attack, she began to have pain every evening, the pain radiated to her hand and travelled down the anterior aspect of the arm and forearm, involving all the fingers. It was spasmodic, but there was persistent numbness and tingling in the hand and arm, which prevented her from lifting and gripping objects. Movement of the shoulder aggravated the condition but coughing had no effect upon it. In March 1950 the condition became so bad that she had to give up work and her general health deteriorated.

There were no other disturbing sensations in the other limbs. Eighteen months prior to admission she began to develop a productive cough. This was most troublesome when she went to bed. Sputum was mainly purulent, but was sometimes white and frothy. There had never been a haemoptysis. For some years she had been unduly breathless on exertion. This breathlessness had progressed in recent months. There was no dyspnoea at rest. For a few months she had been unusually easily tired and her weight had decreased.

Previous Health. She stated that occasionally at school she had had some pain in her axilla.

Family History. Her mother and sister showed cutaneous neurofibromata and cafe au lait pigmentation of some of the skin areas.

Examination. She was a small thin woman of rather dark sallow complexion. Facial skin was covered with freckles. There was no cyanosis or oedema. Finger nails were not atrophic, but were more convex than usual. There were pedunculated and sessile skin tumours on neck, chest, abdomen and right wrist.

Respiratory System. The thorax was moderately well

developed. Movement was relatively diminished at the right apex. Dullness was present in this area. Breath sounds in this area were bronchial. A few scattered rhonchi were heard at both lung bases. Cardio-vascular system and central nervous system appeared to be relatively normal, excepting that the patient showed definite weakness of muscle power in all the muscles of the right arm and shoulder. A significant degree of wasting was detected in the right hypothenar muscles. Skin sensation of the right arm was a little impaired. Otherwise, the central nervous system was normal.

8.6.50. X-ray Report, Dr. Donald. "There is a dense and very well circumscribed opacity occupying the right apical region. It has caused some displacement of the trachea to the left side. The appearances are those of neoplasm".

9.6.50. X-ray Report, Dr. Donald. "Mass at right apex seems most likely to be a lung carcinoma. There appears to be some loss of bone detail in the first right rib suggesting invasion. Right arm - There is an area of translucency in the right humerus as indicated, suggesting metastases".

13.6.50. Operation - Mr. Fraser, Mr. McLuskie.

Dr. Robson -
Pentothal,
Cyclopropane,
Gas & Oxygen.

A short paravertebral incision centred over the 4th right rib was made. The 4th rib was resected in its posterior half and immediately a hard tumour mass could be felt. The pleura was stripped downwards to expose the surface of the tumour which lay extra-pleurally. While doing so, the pleura was torn. A firm capsule over the tumour was incised and a portion of the tumour was removed. It was purply-grey in colour, bled freely, but was perfectly smooth and free of attachments to surrounding structures except on its mediastinal aspect. The bleeding from the tumour was controlled by sutures. The pleural tear was not closed and the wound was sutured in layers.

19.6.50. She had made an uneventful recovery.

19.6.50. Royal College of Physicians Report, Dr. Lees.

"Specimen taken from the skin:-

1. This showed a subcutaneous neurofibroma.

2. The tumour was not sharply demarcated from the surrounding collagenous connective tissue of the corium.

3. The tumour cells are elongated, have oval nuclei, and are embedded in the fine wavy fibrillar matrix which, however, at the periphery of the tumour nodule becomes coarse and collagenous.

4. The nuclei have often a whorled arrangement, and each whorl cell appears to have arisen by proliferation of the sheath cells of a small nerve twig, which can often be seen in the centre of the whorl. There is no palisading of the nuclei, however.

5. The tumour cells are regular in size and show few, if any, mitotic figures.

6. No malignancy.

Specimen 2. This was a fragment of loose connective tissue with no obvious nerve elements.

Specimen 3. Taken from the mediastinum:-

1. This fragment is formed predominantly of interlacing bundles of collagenous connective tissue.

2. In one area the tissue is more cellular, with the nuclei oval or sausage shaped and these long nuclei are sometimes corrugated like neurilemminal cells. The matrix too is here finely fibrillar. These cells are arranged in interlacing fasciculae

and there is no pallisading of the nuclei.

3. This part of the tumour has a cell type of a nerve cell sheath tumour but the characteristic whorling and pallisading is absent.

A few of the skin tumours - There is little doubt that this too is a neurofibroma, although this picture is more fibromatous than neurilemminal.

4. No evidence of carcinoma or epithelial tumours.

5. No malignancy, no tuberculosis.

6. Benign Neurofibroma".

20.6.50. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Cyclopropane,
Gas & Oxygen.

The paravertebral incision was re-opened and continued postero-laterally into the axilla. The 5th rib and anterior portion of the 4th rib were resected and an opening made into the pleura. A moderate amount of heavily blood stained fluid escaped. The tumour was extrapleural and posterior and lay in contact with the posterior ends of the upper four ribs and their corresponding vertebrae. A thick capsule of tumour was incised and separated from the tumour. The separation was continued until it was attached only by a pedicle which arose from near the neck of

the first rib. The pedicle was clamped and the tumour removed. Part of the capsule was excised and after securing haemostasis the remainder of the capsule was stitched together to form a small sac. A pack was inserted over the closed capsule and brought out through the posterior end of the wound. The ribs could not be approximated and closure was made using only muscle. A drainage tube was inserted.

21.6.50. The pack was removed and the wound was stitched.

26.6.50. Drainage tube was removed and the chest was aspirated.

28.6.50. The patient died suddenly in theatre when the chest was being aspirated.

22.6.50. Pathological Report, Mr. K. Fraser.

"This is a greyish white oval tumour measuring 9 x 7.5 cm. It is completely encapsulated by a thick capsule which measures .25 cm. in diameter. The cut surface shows greyish white strands arranged in whorls. The tumour is a typical neurofibroma".

22.6.50. Royal College of Physicians Report.

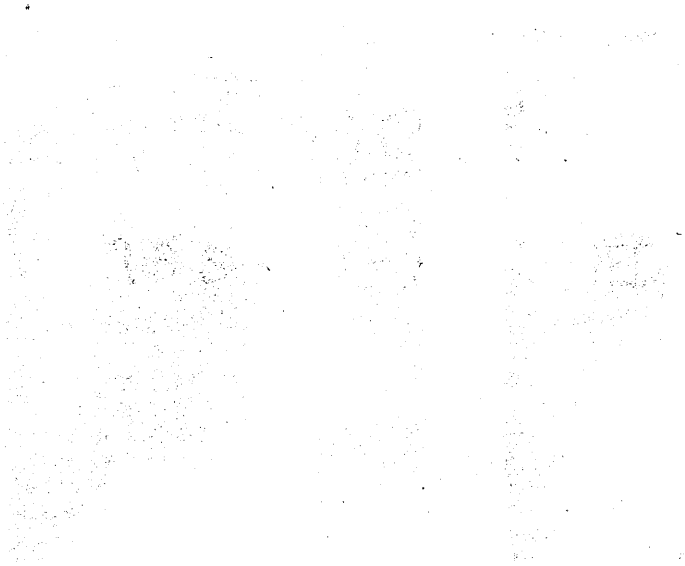
Dr. Lees. "1. A Neurofibroma.

2. The capsule is formed of fibro-fatty tissue generally loose in structure although there are some dense collagenous bands. This capsule is very vascular. There are many well formed capillaries. Also seen are irregular channels lined by a single row of irregular cuboidal epithelial-like cells. The irregularity of outline of these channels is due to the projection into the lumen of blunt processes of fibrous tissue which push the lining membranous cells before them. These channels are filled with blood. They are presumably vascular channels, forming an irregular plexus on the surface of the tumour. It may be that these are greatly distorted lung acini with epithelium transformed to cuboidal type. Diffuse infiltration by lymphocytes and plasma cells.
3. The tumour itself is formed by a diffuse sheet of fairly small uniform cells with oval and elongated nuclei embedded in the loose fibrillar matrix. The matrix in some areas is more dense, and may even be definitely collagenous, when the cells then assume the character of fibroblasts. There is a diffuse scattering of lymphocytes, particularly at the periphery of the tumour close to the capsule. An

unusual feature too is the presence of a group of lymphoid filled large macrophages embedded between the cells of the tumour. The tumour cells show no whorl formation and the tumour shows much fibromatous change, and in areas is indistinguishable from a fibroma.

4. The tumour cells are irregular in size and shape, with few, if any, mitotic figures.

5. No malignancy".



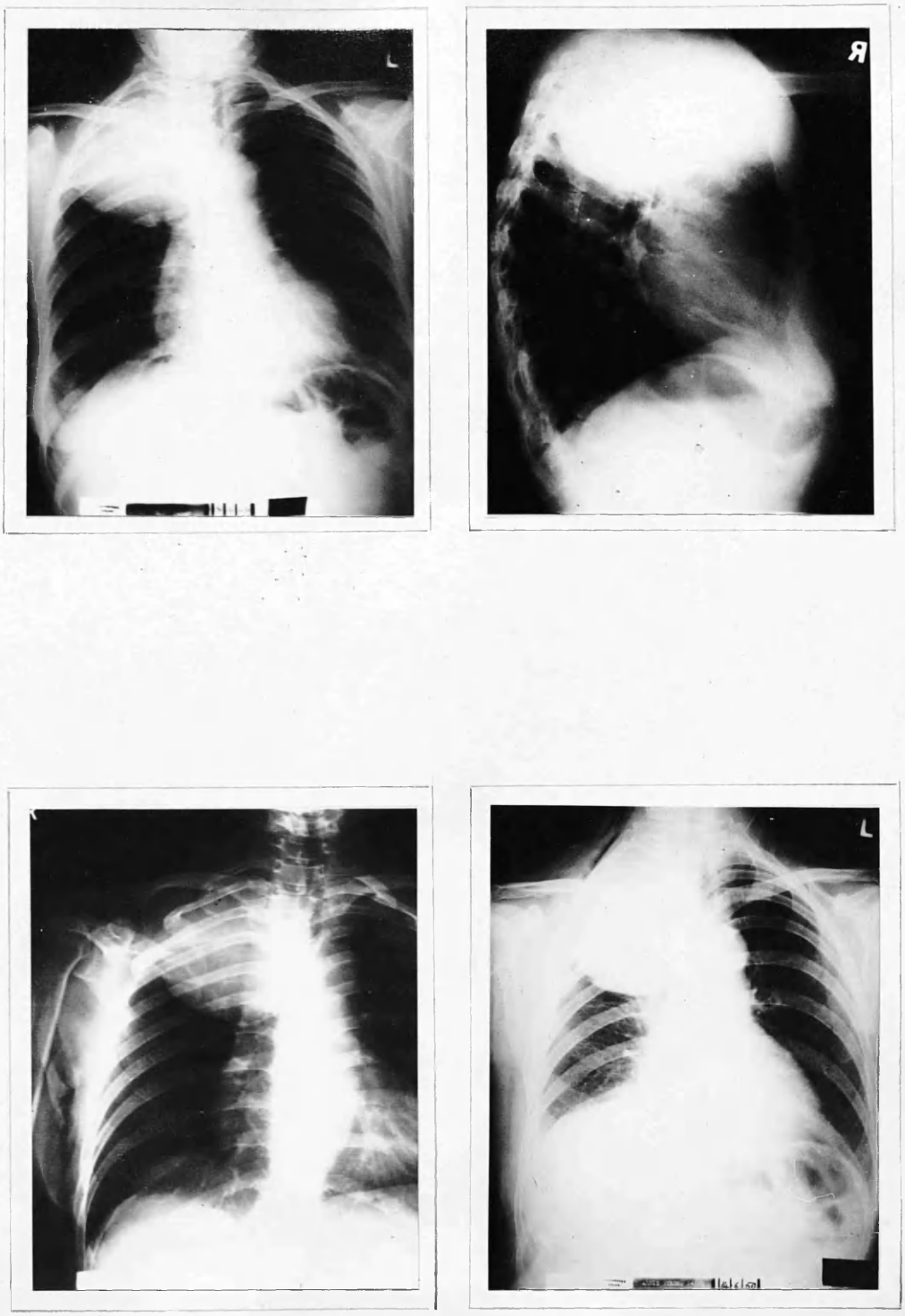


Fig.22. A neurofibroma. The typical site is exemplified. This tumour was attached to the lowest trunk of the brachial plexus.

Fig. 23. The specimen illustrates the usual rounded appearance found in these tumours. It measured 9 x 7.5 cm.

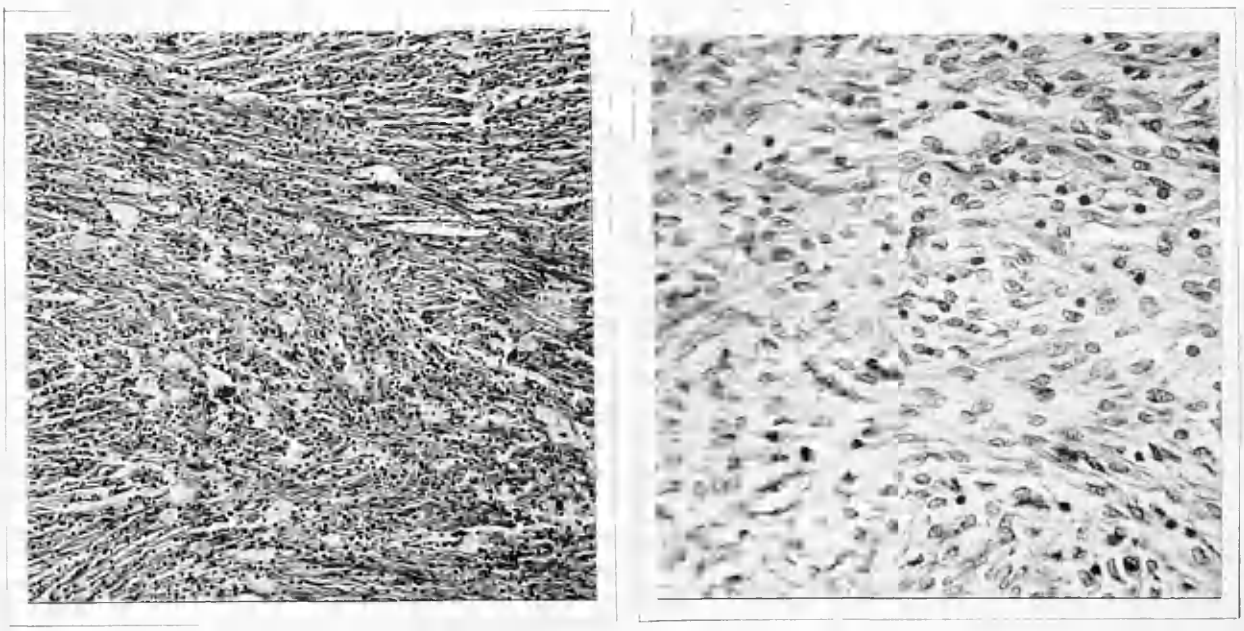


Fig. No.24. The histological picture of the neurofibroma.

Case No. 10.

J.McK. (55). Occupation - Labourer.

Admitted 10.7.46,

Dismissed 3.8.46.

Diagnosis. Ganglioneuroma of mediastinum.

History. During the 6 months prior to admission he had suffered from a slight and persistent cough with sputum. He had had some breathlessness on exertion and he had felt gradually more tired. His appetite was good but he had lost a considerable amount of weight. There had been no haemoptysis. No upset of bowel or bladder habit.

Previous History. In 1915 - jaundice while in the Army in Egypt. 1919 - discharged from the Army with D.A.H. 1941 - he was operated on in Glasgow Royal Infirmary for duodenal ulcer, when a gastro-enterostomy was carried out.

Examination. He was a very thin toxic looking elderly man. There was no cyanosis or clubbing of the fingers and no undue prominence of veins.

Respiratory system. The anterior end of the third left rib was unduly prominent and had been so since childhood. The chest was resonant

throughout; the respiratory murmur was vesicular though slightly increased at the right base posteriorly. Vocal resonance was slightly diminished at the right apex.

Cardio-vascular system
Alimentary system
Central nervous system
} showed no abnormality.

10.7.46. X-ray Report, Dr. McKail. "There is a wedge shaped opacity with apex towards the hilum in the right upper lobe and the lateral view confirms this to be due to atelectasis of the apical segment of the right upper lobe. There is scoliosis of the upper dorsal spine with convexity to the right and apparently compressing the trachea above its bifurcation.

The appearances confirm a primary early carcinoma with endo-bronchial tumour situated in the apical branch of the right upper lobe bronchus".

22.7.46. Operation - Mr. Dick. Dr. Pinkerton - Pentothal, Cyclopropane.

A curved incision along the vertebral border of the right scapula was made.

The posterior fragment of the 3rd right rib was removed and on stripping the pleura forward a hard bossy mass was found lying in the costo-vertebral angle of the posterior part of the superior mediastinum. Small fragments were removed for biopsy. Chest wound closed.

30.7.46. The wound was clean and dry.

2.8.46. Tissue reported at Victoria Infirmary, Dr. Adler. "Histological examination of the rib specimen shows a ganglioneuroma. The greater part of the tissue is formed by very pale loose fibres, the greater part of them representing either grey nerves or nerve sheath. There are only very few tiny capillaries and no large vessels present within the actual tumour. Its cellularity is very low and there is no evidence of increased activity. There are very few ganglionic cells; some of these are surrounded by sheath cells. Their formation and nuclei are quite regular. The marginal area of the specimen is formed by fat. There is no evidence of cartilage or chordoid tissue".

3.8.46. He was discharged well.

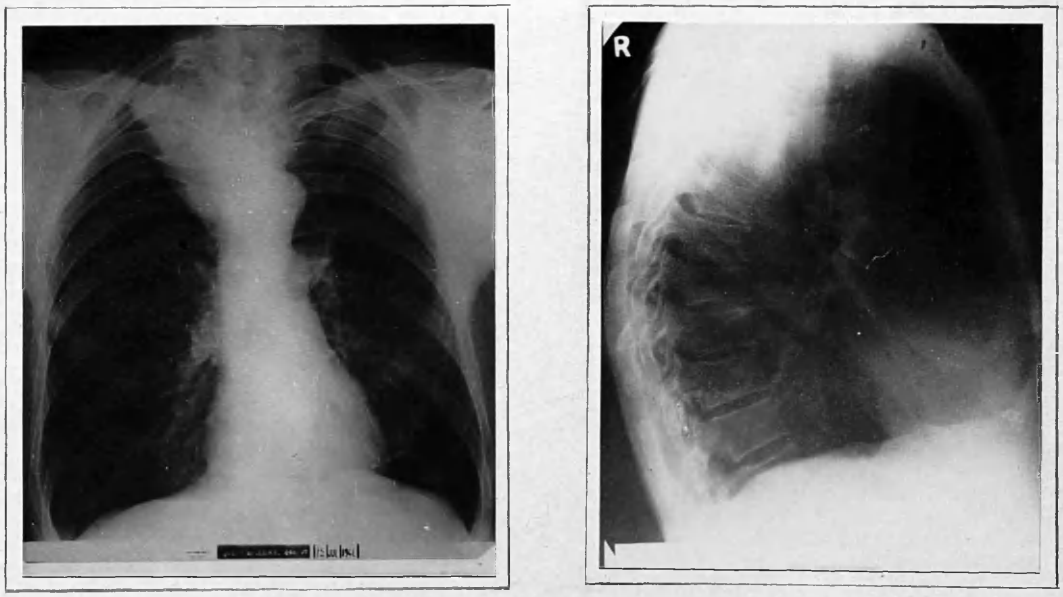


Fig. No.25. Wedge shaped shadow in the apex of the right chest due to a ganglioneuroma lying in the paravertebral gutter. The shadow was mistakenly diagnosed as carcinoma of the right upper lobe.

Case No. 11.

E.T. (40). Occupation - Housewife.

Admitted 28.4.44,

Dismissed 21.5.44.

Diagnosis Neurofibroma of posterior mediastinum.

History. Two years prior to admission she began to complain of breathlessness on exertion, accompanied by weakness and general malaise. She had a dry cough but no sputum. One year later she began to have a feeling of discomfort across her back but she had had no actual chest pain. There had been no haemoptysis. Bowel and bladder habit had been normal.

Previous Health. She had had attacks of bronchitis during the preceding seven years and in addition had suffered from rheumatism of her hands, arms and feet. She had no history of rheumatic fever, pneumonia or pleurisy. She had had scarlet fever and diphtheria when 4½ years old.

Family History. Her mother died with a cerebral tumour; her father died in old age; three sisters were healthy.

Examination. Well built and of good colour with

no enlarged glands or cyanosis.

Respiratory system. The chest was symmetrical but rather restricted in movement and vocal resonance on the right side of the chest was slightly diminished. A few medium rales were heard throughout the right side.

Cardio-vascular system
Alimentary system
Genito-urinary system
Central nervous system
} All showed no abnormality.

Blood pressure 130/70.

28.4.44. X-ray Report, Dr. McKail. "Homogeneous opacity of spherical outline is present, occupying the upper zone of the right hemithorax; it is well defined".

3.5.44. Diagnostic pneumothorax. 700 ccs. of air were instilled into the chest and produced collapse of the lung which fell below the tumour. Diaphragm was seen to move and there was a trace of fluid. 400 ccs. of air were withdrawn.

7.5.44. Operation - Mr. Dick, Mr. Fraser.
Dr. Pinkerton - Pentothal, Cyclopropane.

The chest was opened by the usual right postero-lateral incision. The tumour was found

lying in a sac of pleura from the dome of the thoracic cage and lying above the level of the azygos vein; it was spherical and hard in consistency. The tumour was removed without much difficulty after the pleural covering had been elevated. The tumour base appeared to be attached about the neck of the second interspace just lateral to the body of the vertebrae. The pleural sac was sutured back in place and the space beneath it was packed with gauze packing.
The chest was closed.

A blood transfusion was given during the operation.

17.5.44. She progressed very well and was allowed home on 31.5.44.

Pathological Report, Mr. K. Fraser. "This is a greyish white tumour of almost spherical shape measuring 10 x 8 x 8 cm. It is apparently encapsulated and is of hard elastic consistency. On a section, it shows bands of short fibres running across its substance in all directions, with here and there tiny punctate haemorrhages.

Histological picture shows the

appearance of neurofibroma, no ganglion cells being seen".

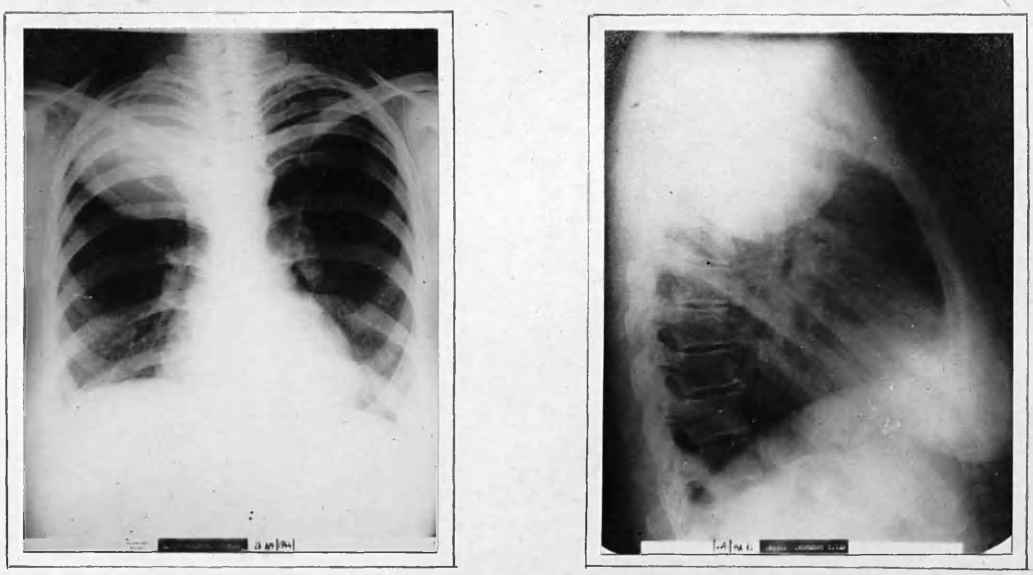


Fig. 26. Typical site and density for neurofibroma. This tumour was attached to the second intercostal nerve.

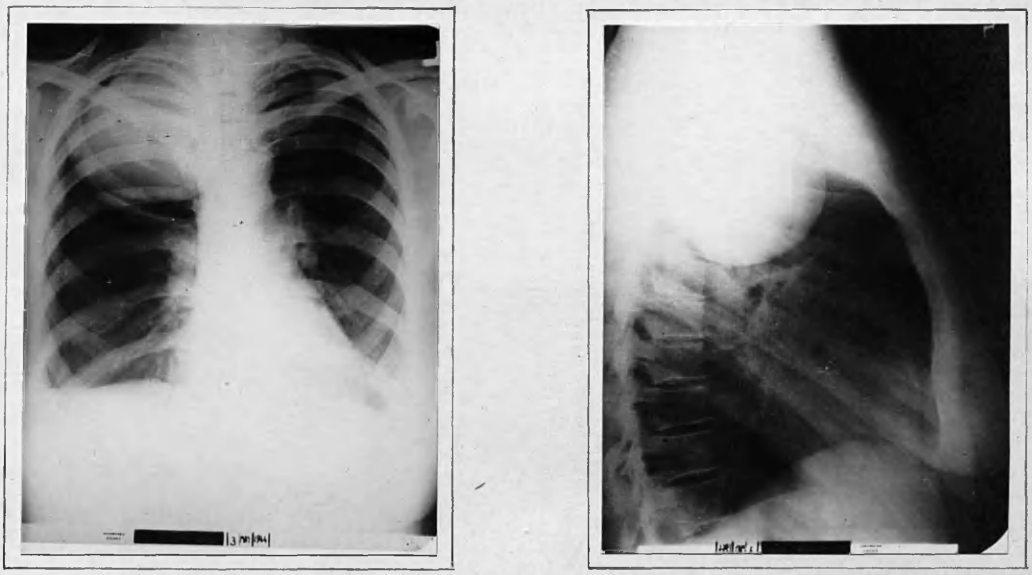


Fig. 27. An artificial pneumothorax has been induced. Some air has risen above the lateral and superior aspect of the neurofibroma; the lung has dropped below the tumour.

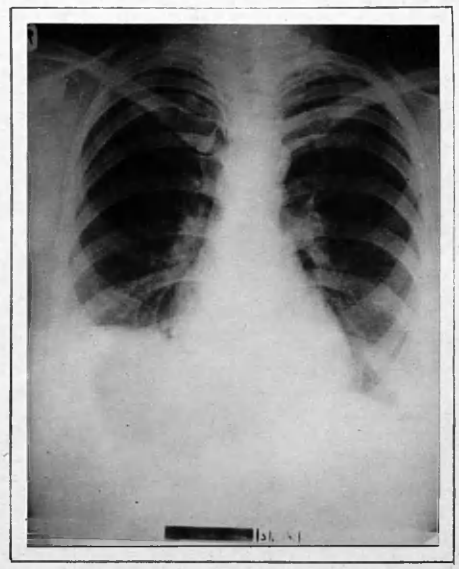


Fig.28. X-ray of the chest two weeks after removal of the tumour.

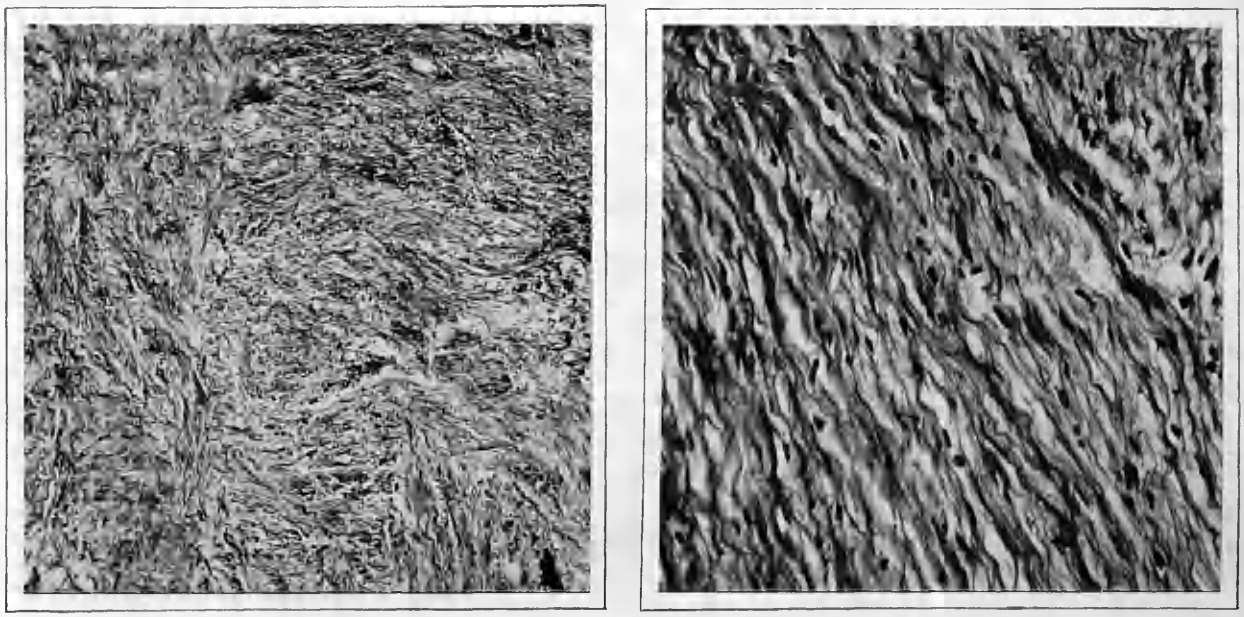


Fig. 29. A fairly densely collagenous tumour, simple fibroma probably of nerve sheath origin.

Case No. 12.

M. MacD. (3).

Admitted 28.7.41,

Dismissed 4.9.41.

Diagnosis Mediastinal ganglioneuroma.

History. She was born at 7½ months after a labour lasting four days, at birth she weighed 5lb.5oz. At first small and puny, she progressed very well and talked and walked at the normal age; she was, if anything, of precocious intelligence. She had no illness until she was about 3 years of age when she developed a cold with a cough. The cough cleared up but recurred in February and resisted treatment, her temperature remaining elevated. She was seen by Dr. Riddell Campbell who diagnosed pneumonia; consequently she was admitted to Ruchill Hospital for three months and following investigations there she was transferred to the Western Infirmary with a diagnosis of neoplasm, probably neurogenic, of the posterior and superior mediastinum.

On admission to the Western Infirmary she was well, apart from occasional harsh cough with sputum; no blood had ever been seen in the spit.

Examination. She was a healthy, happy looking young

child. No enlarged glands were found; no wasting and no deformity of limbs was seen.

Operation - Mr. Bruce Dick, Prof. Illingworth, Dr. Tindal. Cyclopropane, Gas, Oxygen, Ether.

A curved incision was made below and behind the right scapula and chest was opened through the 5th intercostal space. The tumour was found to be lying posteriorly and was projecting into the pleural cavity. It was not cystic and its appearance suggested a ganglioneuroma, the tumour being enucleated without difficulty. There was no extension into the intervertebral foramina. A drain was inserted into the pleura and the wound was closed.

Pathological report. Mr. K. Fraser. "The tumour was greyish white in colour, about 9 x 6 cm. in size and it showed a tendency to lobulation. A homogeneous white surface was found on section. Across the surface various bands of fibrous tissue ran, giving the tumour in places a somewhat whorled appearance".

Histological report. There are a number of ganglion cells present. On the whole the tumour is much more immature than is usual in the typical neurogenic tumour. There is no attempt at the formation of clearly defined bundles of sympathetic fibres usually seen

in the mature ganglioneuroma.

4.9.41. She made an uneventful recovery and was dismissed home.

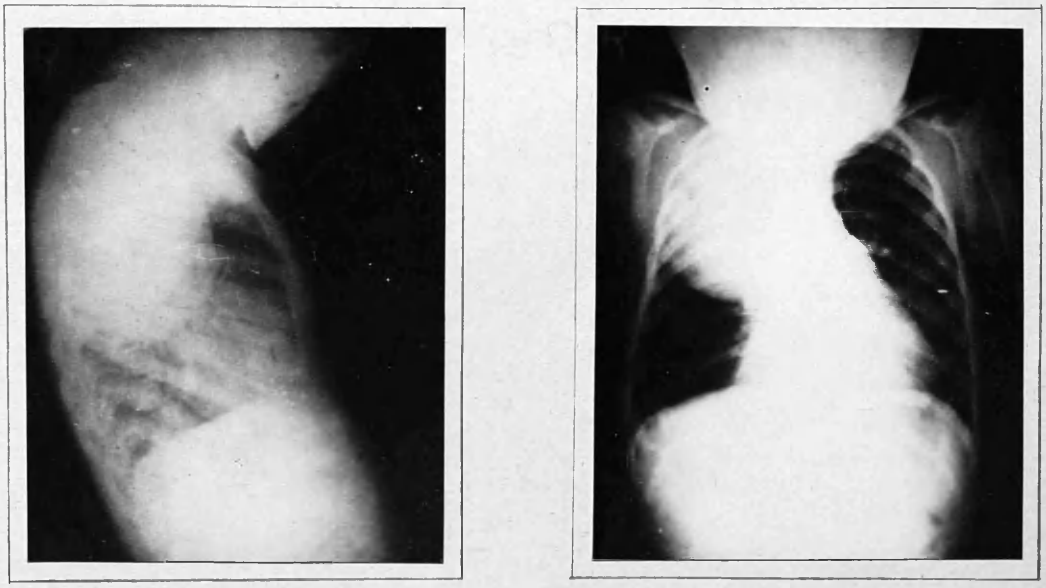


Fig. 30. X-rays of a 3 year old child showing classical appearances of an intrathoracic nerve tumour.

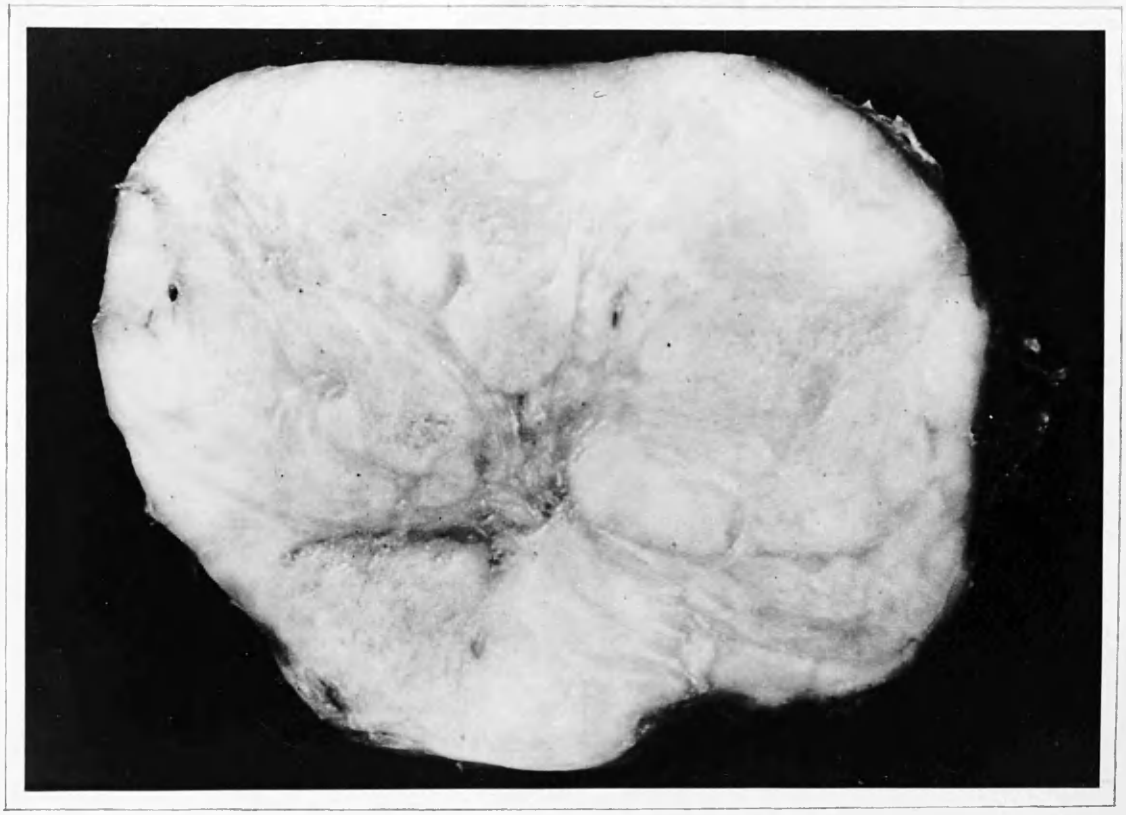


Fig. 31. Cross section of the tumour. The lobulation is well seen.

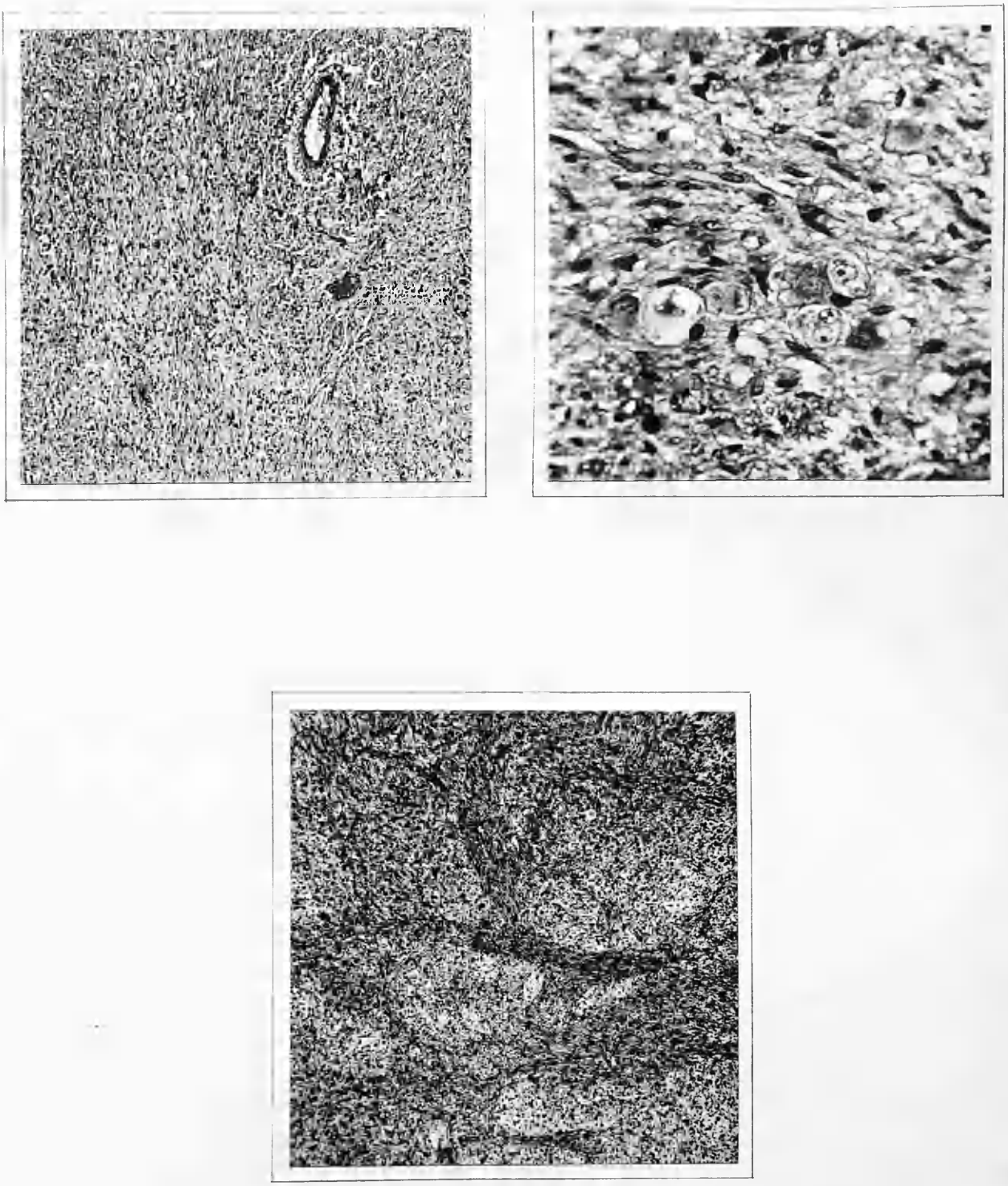


Fig.32. Histological sections of the tumour. A few ganglion cells are present. The tumour cells are much more immature than in the other cases.

Case No.13.

M.F. (52). Occupation - Assistant Restuarant Manager.

Admitted 2.11.46, 22.1.47,

Dismissed 6.12.46. 4.2.47.

Diagnosis Epidermoid cyst of posterior mediastinum.

History. Since early manhood he had been breathless on undue exertion and in addition had suffered frequently from colds which settled in his chest. In 1933, after a particularly bad bout of "colds" he was left with a residual cough and spit. At that time an X-ray examination was carried out and revealed a mass in the upper zone of the right chest. Since that time he had been under repeated observation and review.

At the time of admission he still suffered from repeated coughs and colds and was very breathless when he had a cold. He had been particularly breathless during 1946 and had suffered from a hacking cough which was usually precipitated by a change of temperature. He had had a moderate amount of yellowish white sputum which had no smell or taste. There had been no loss of weight. His appetite was moderately good.

Examination. He was a slim man; he looked his years but suffered from stridor and his voice was slightly husky. There was no oedema, cyanosis or jaundice.

Respiratory system. The right chest was prominent in the upper third anteriorly and the movement in this area was slightly diminished. The percussion note in the upper third of the chest was impaired. Respiratory murmur was vesicular but air entry was greatly diminished and there were numerous rhonchi.

Cardio-vascular system. No abnormality.

4.11.46. X-ray Report, Dr. Stenhouse. "There is a dense rounded opacity occupying the upper posterior part of the right lung field. Its margins are sharply defined. Among the possible causes are ganglioneuroma, pleural effusion and hydatid cyst.

Films of spine and ribs and bronchoscopy might give further information".

22.11.46. X-ray Report, Dr. Stenhouse. "There is no evidence of erosion of right upper ribs or upper dorsal spine. It is rather against the diagnosis of ganglioneuroma, neurofibroma and malignant disease".

He was put on to breathing exercises and a diagnostic pneumothorax was carried out.

6.12.46. He went home and reported for re-admission on 22.1.47, when the physical examination was found to be unchanged.

4.2.47. Operation - Mr. Dick. Dr. Pinkerton - Pentothal, Cyclopropane.

Right postero-lateral incision which exposed the sixth rib, which was excised. A tumour was found lying in the paravertebral gutter, extra-pleural in site and was about 5" x 4". It was felt on examination to be a partly loculated cyst. Some of the fluid was aspirated from the tumour and was yellowish grey in colour and had a slight sheen. The tumour shelled out fairly well and had no obvious connection with an intercostal nerve. The tumour bed was covered with pleura and the chest was closed. The patient died three hours later.

Post-mortem examination was carried out. Extracts from Post Mortem report, Dr. Halcrow.

"Serous sacs; Right pleura sac contained about ¾ pint of bloody fluid. Left pleural sac normal.

Peritoneal and Pericardial sacs normal.

Respiratory System: Trachea Congested.

Both lungs were collapsed - almost, but not quite complete collapse. On section they were firm and purplish in colour. Bronchi normal.

Liver: Normal.

Gall-Bladder: Normal.

Kidneys: Normal.

Heart: Superficial vessels normal. Coronary arteries normal. Myocardium of left ventricle was hypertrophied. Right ventricle slightly dilated. Endocardium normal. Valves normal.

Aorta: Fairly marked fine atheroma.

ABSTRACT OF HISTOLOGICAL REPORT ON ORGANS:
(R.C.P. Ref. No. 3142/772-7).

(1) Lungs: Microscopical examination showed areas of partial collapse but not to the point of total obliteration of alveolar structure. Intra-alveolar haemorrhages in some places - may be ante - or post-mortem.

(2) Liver: Normal histologically.

(3) Spleen: -do- -do-

(4) Heart: Myocardium of healthy appearance.

(5) Kidney: Within normal histologically.

SUMMARY:

Cause of death was:

(1) Dermoid cyst - R. lung - surgical removal.

(2) Acute Pulmonary Atelectasis.

Histological findings were indefinite, and apart from partial collapse of the lungs, they revealed little of abnormality. The immediate cause of pulmonary collapse was not obvious. There was no evidence of obstruction in upper air passages."

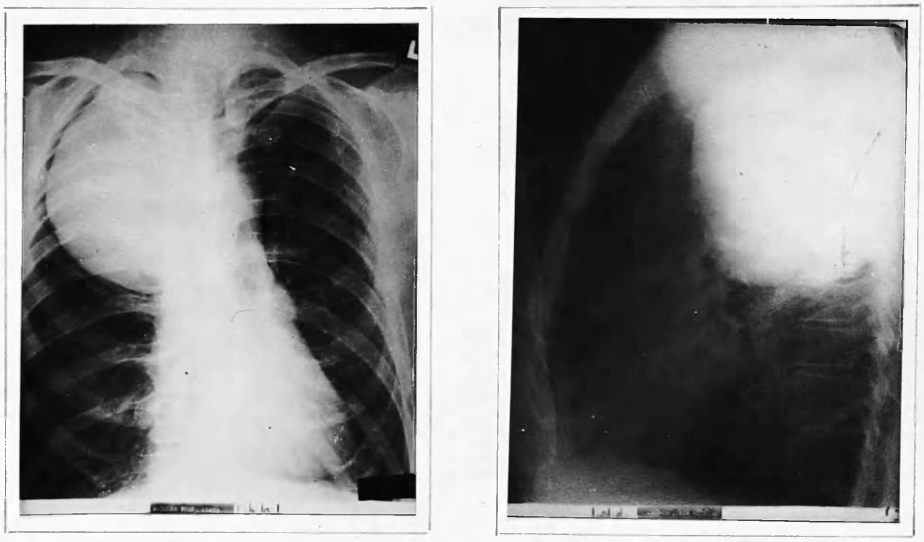


Fig. No. 33. The x-ray film on the left following induction of an artificial pneumothorax; the lung has fallen away from the chest wall and from the tumour. Air has passed round the outer side of and above the cyst. The x-ray film on the right shows the cyst lying posteriorly in the superior mediastinum.

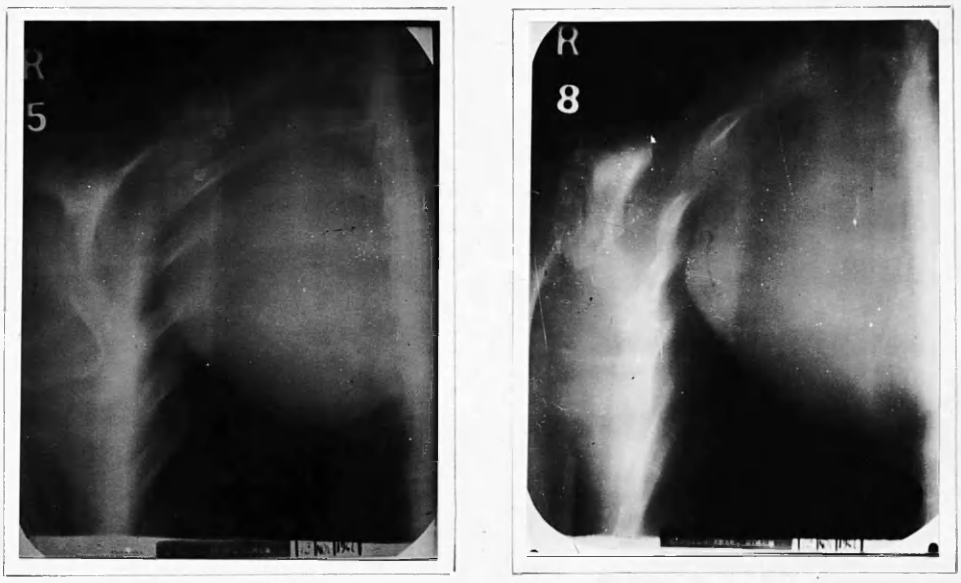


Fig. No. 34. The tomographic appearances at 5 and 8 cm. from the back; thus confirming the posterior postion of the cyst.

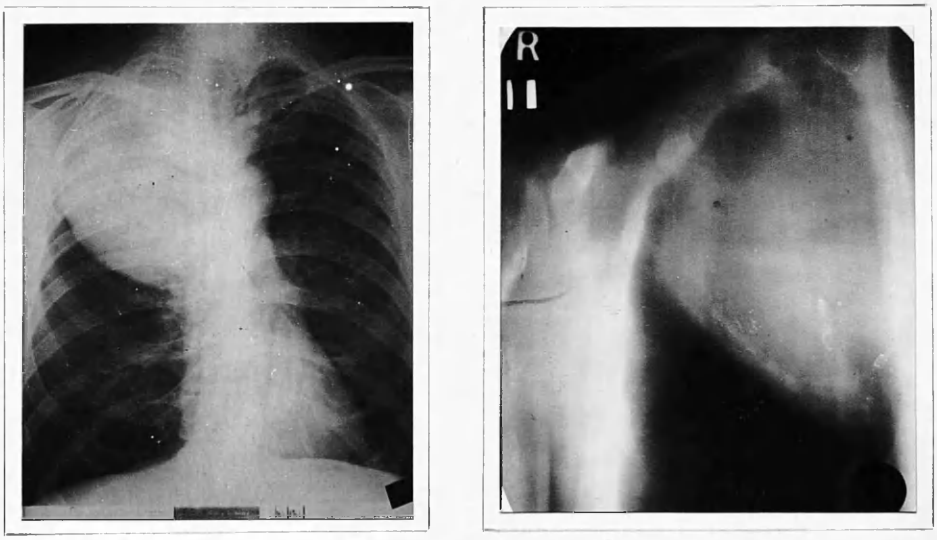


Fig. No. 35. Epidermoid cyst in the posterior mediastinum. The x-ray film on the right shows the tomographic appearance at 11 cm. from the back indicating that the cyst is now being "lost" on the tomograph "cuts".

Fig. No. 36. The external appearance of the preserved cyst.

Fig. No. 37. The internal aspect of the cyst wall. Many small areas of haemorrhage can be seen.

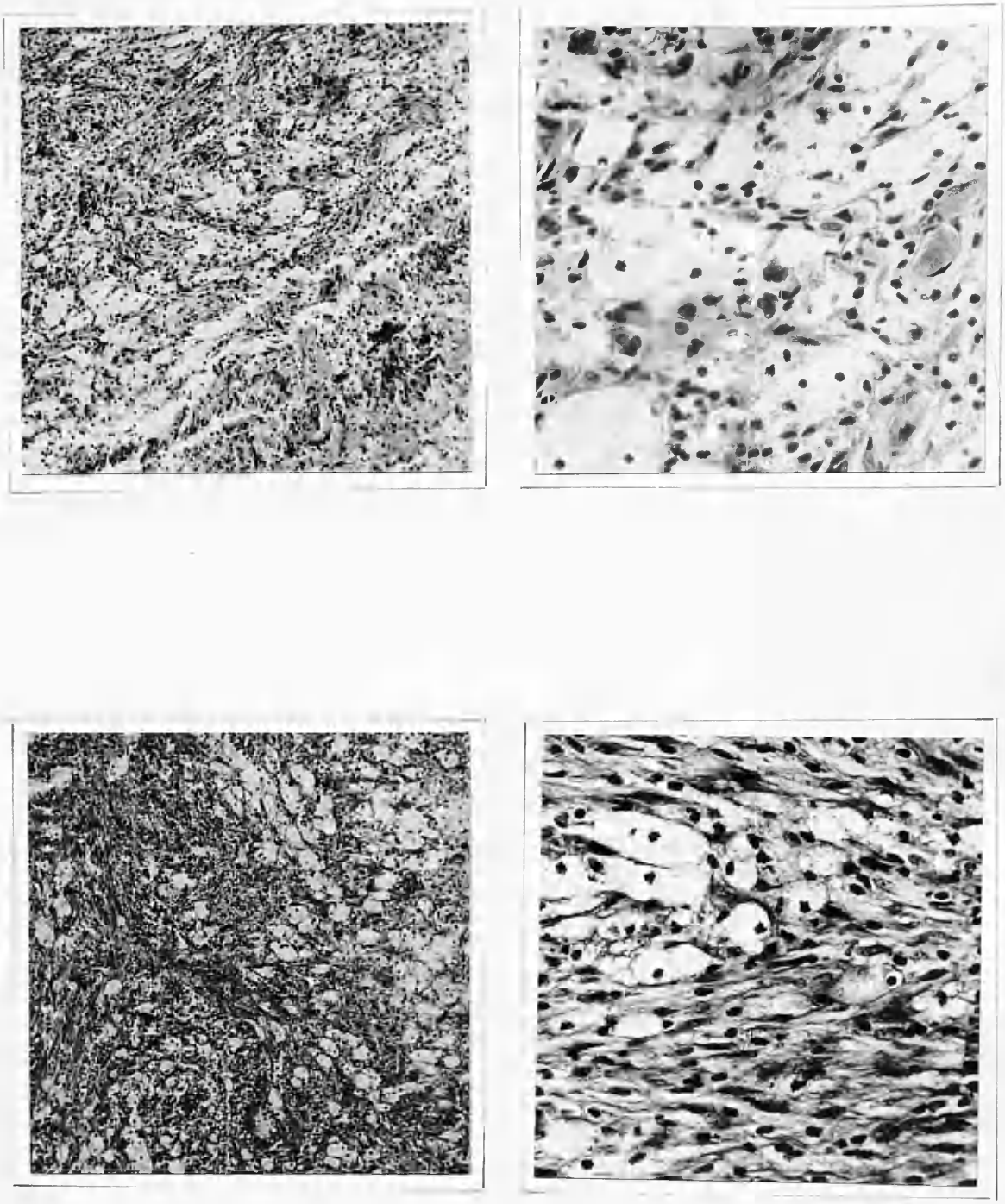


Fig. No.38. Representative histological sections. Many "foam" cells are seen.

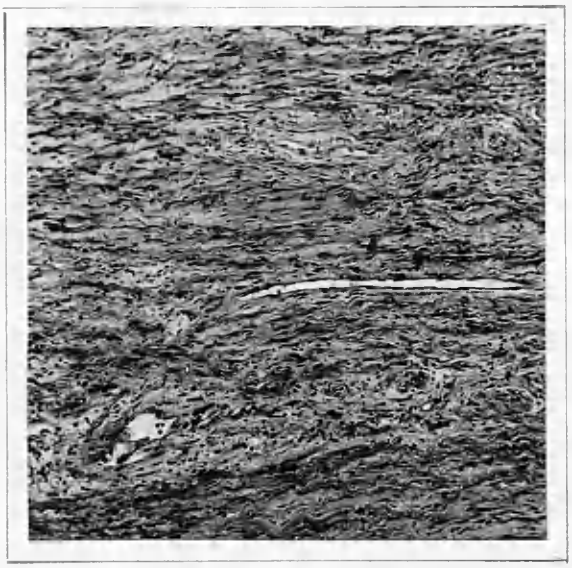


Fig. No. 39. Much fibrous tissue present in the cyst wall.

Case No.14.

J.D. McN . (14). Occupation - Schoolboy.

Admitted 8.2.47,

Dismissed 6.5.47.

Diagnosis Epidermoid cyst of posterior mediastinum.

History. Ever since childhood he had complained of a cough which had been worse during the winter season and which was looked on as bronchitis. About four years ago he began to have a tight feeling in the right side of his chest. This tightness would pass off after a few minutes but re-appeared about every six months. In September 1946, the attacks of tightness became more frequent and he occasionally experienced a sharp pain in the right side of his chest. He had always been breathless on exertion.

Previous history. At six months he was in the Royal Hospital for Sick Children with a cyst at the base of his right lung. This cyst was aspirated and several subsequent X-ray photographs were taken and were reported as being clear. He had had measles at the age of 8 years and jaundice when 13.

Examination. He was a well nourished intelligent but slightly undersized boy for his age.

He was of good colour and there was no cyanosis or dyspnoea and no clubbing of the fingers. He had a deep cough which was almost bovine in character.
Respiratory system. There was a mild scoliosis to the left. Movement in the right side of the chest was restricted and the percussion note was impaired at the right base. There was no alteration in breath sounds, which were puerile in character. Vocal resonance and vocal fremitus were diminished over the right base posteriorly and there was no whispered pectoriloquay.
Other systems N.A.D.

13.2.47. Laryngoscopic examination report, Dr. Howie. "The larynx is negative".

16.2.47. Aspiration carried out and yellow grumous fluid obtained. No hydatid elements were seen. Cells were - Poly. 87%,
Lymphocytes 13%,
Culture was sterile.

24.2.47. 340 ccs. light brown fluid removed.

26.2.47. 250 ccs. of fluid aspirated from the chest.

All examinations of these specimens were negative,

including guinea pig inoculation.

Protein content of the fluid was 3.5%. Fat 2.7%.

6.3.47. X-ray of chest shows great reduction in the size of the cyst.

10.3.47. Diagnostic pneumothorax. "This showed a shift in the position of the cyst".

28.3.47. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Cyclopropane.

Right postero-lateral incision and the chest was entered through the sixth interspace. The cyst was found to be extra-pulmonary in site and attached to the posterior chest wall by a pedicle with attachments at the necks of the 7th and 8th ribs.

The cyst was removed without damage to the lung tissue.

The wound was closed around a pack, after the instillation of penicillin.

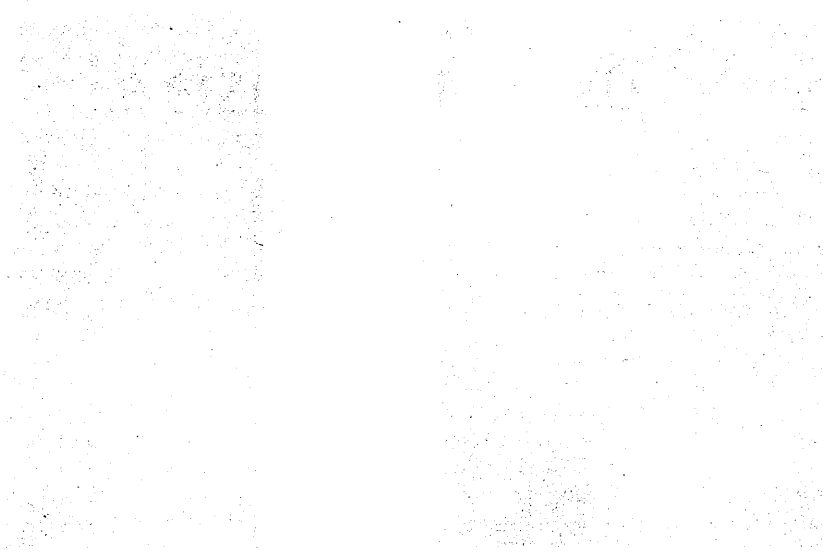
30.3.47. Pathological Report, Mr. K. Fraser.

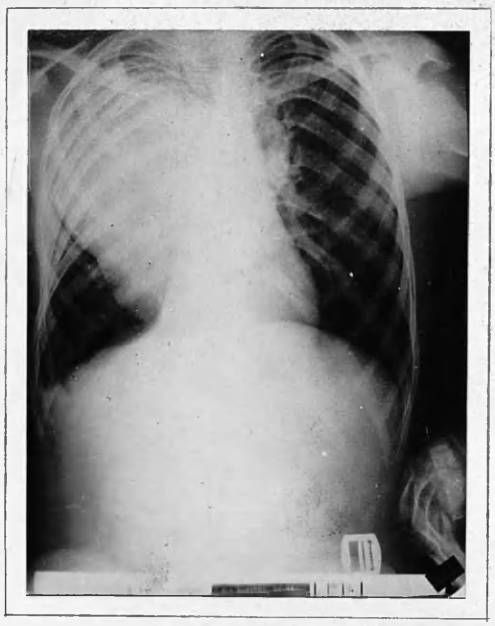
"After preservation, the cyst measured 10 x 7 cms. The wall of the cyst showed varying thickness, from 2 cms. to 2 mms. in diameter. Many hard yellowish white plaques of cartilage on the wall, giving the

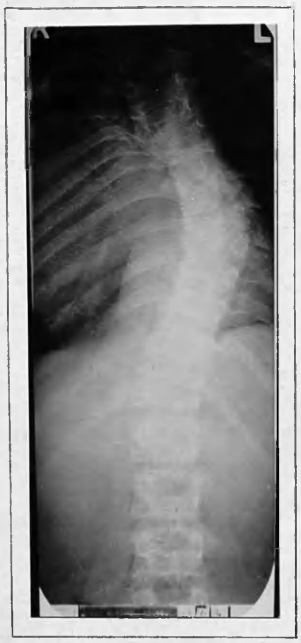
wall a yellowish white appearance, striated by reddish strands rather like muscle".

31.3.47. Pack was removed and the chest was aspirated as required.

He was eventually allowed up and went home well on 6.5.47.







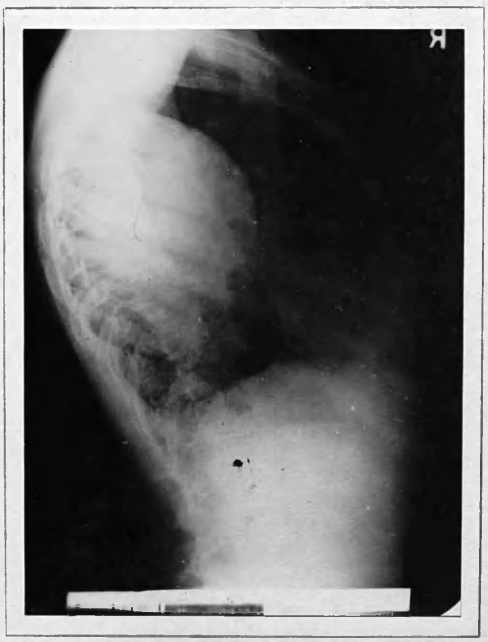
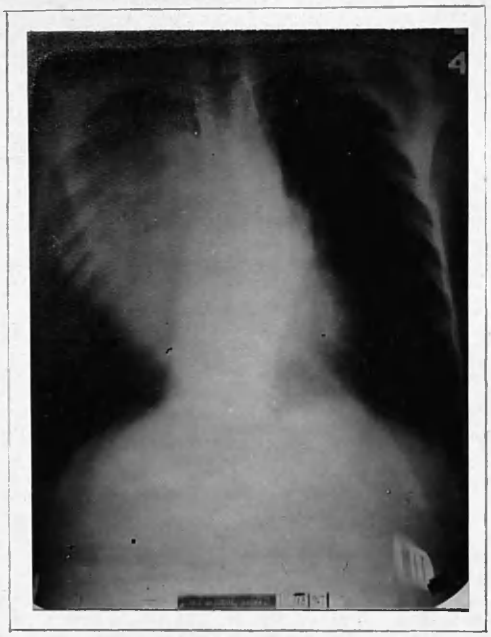
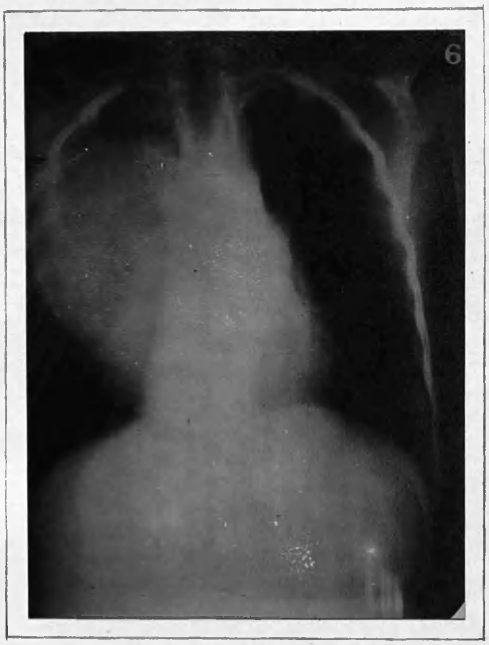
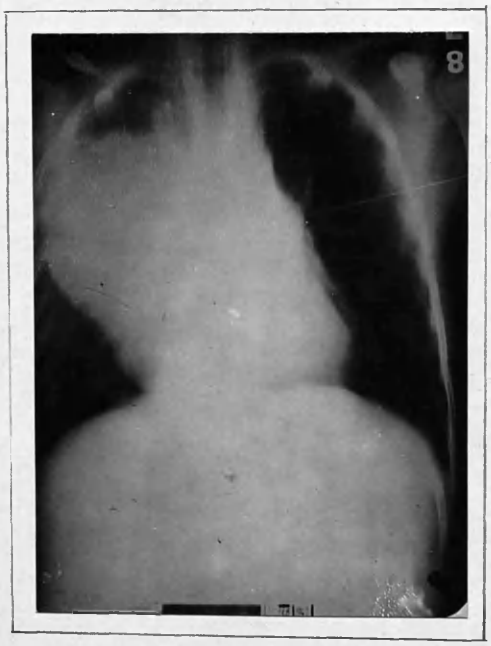


Fig. No.40. Epidermoid cyst of the left posterior mediastinum. The well marked scoliosis and kyphosis are clearly seen.







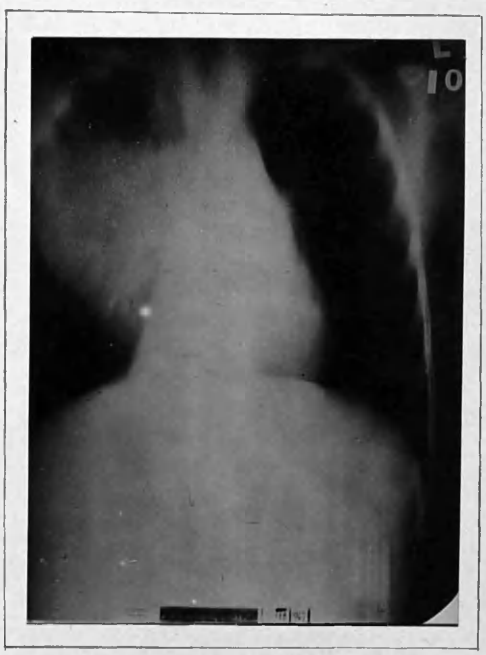
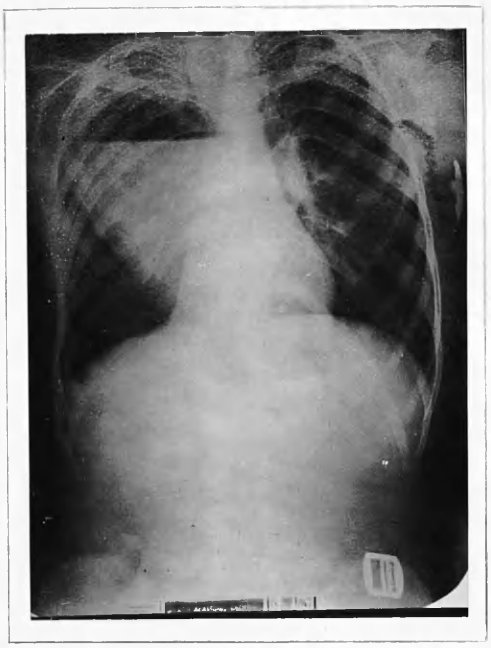


Fig. No.41. Tomographs at 4, 6, 8 and 10 cm. The cyst is best seen between 6 and 8 cm. from the patient's back thus indicating its posterior situation.



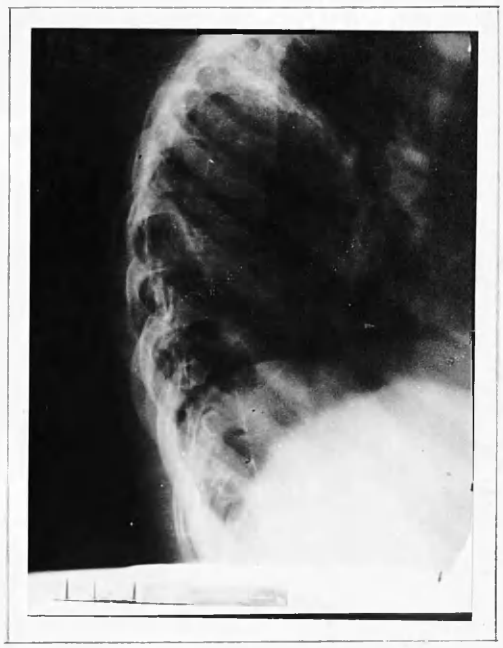
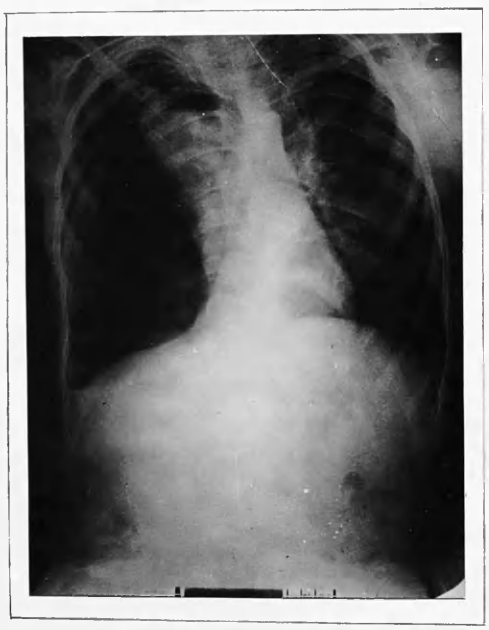


Fig. No. 42. X-ray appearances after the aspiration of several hundred c.c. of grumous fluid. The lateral film confirms the posterior position of the cyst.



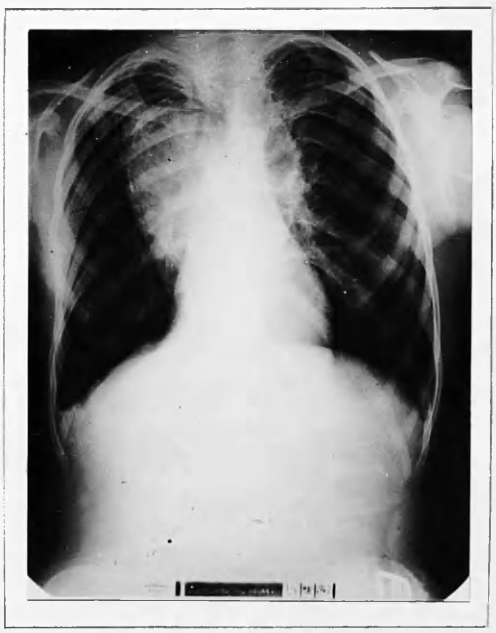
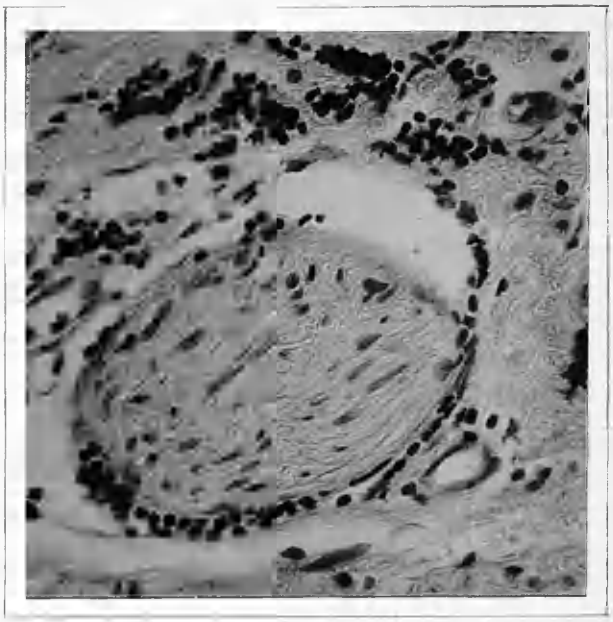


Fig. No. 43. After further aspiration the cyst is greatly reduced in size. The x-ray film on the right shows re-accumulation of fluid within the cyst after a further 16 days.

Fig. No. 44. External appearance of the preserved cyst.

Fig. No. 45. Internal aspect of the cyst.



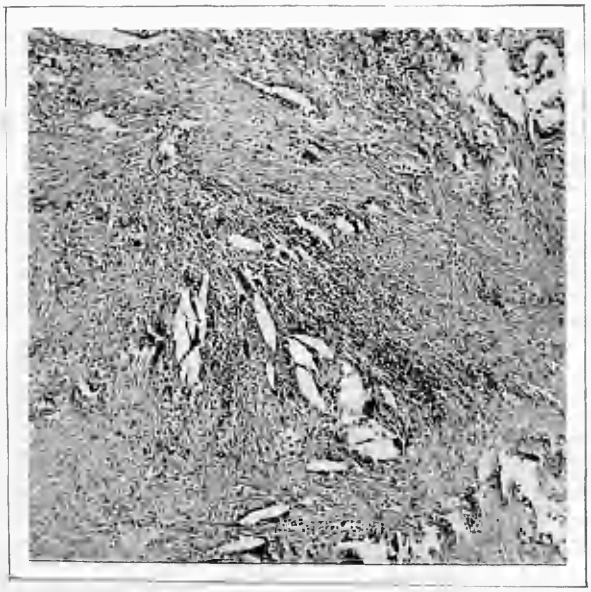


Fig. No. 46. Representative histological sections of the cyst wall. Many "foam" cell spaces are seen.

Case No.15.

D.H. (29). Occupation - Housewife.

Admitted 5.1.49, 10.9.49,

Dismissed 12.1.49, 5.11.49.

Diagnosis Dermoid cyst of mediastinum.

History. In 1945 she was in hospital for five to six months with rheumatic fever. When she was recovering from this attack, she had pain in her chest and the chest was X-rayed. She was told there was a cyst in the left lung.

One year previous to admission she was delivered of twins during which she was perfectly well. Two months prior to admission she was X-rayed as a tuberculosis contact and the cyst was again seen. On admission to Hairmyres she was suffering from sickness and vomiting of pregnancy which had progressed for three months.

Previous Health. Measles and Pleurisy at the age of 5. St. Vitus Dance at the age of 18. In 1941 she was graded unfit for the A.T.S. and the cause was unknown.

Examination. She was a small, fat woman, who seemed quite intelligent and rather nervous.

She still had a tendency to short, repetitive and apparently purposeless movements. There was no clubbing of the fingers, no enlargement of glands and no distension of veins.

Respiratory system. Anteriorly there was diminished movement at the left apex where the percussion note was impaired. The respiratory murmur was everywhere vesicular, but at the left apex anteriorly there was constant crepitation over a small and localised area.

Cardio-vascular system. The heart was of normal size and the heart sounds were of good quality.

Alimentary system. No abnormality.

Central nervous system. Choreiform movements above mentioned.

6.1.49. X-ray Report, Dr. McKail. "There is an ovoid mass in the anterior mediastinum projecting into the left lung and displacing the trachea backwards and the heart to the right. It measures approximately 12 cms. in its longest diameter, and an incomplete layer of calcification is seen just beneath its outer margin. The appearances are most probably due to a dermoid cyst".

13.1.49. The patient was discharged home to return once the pregnancy was completed.

10.9.49. Re-admitted. She had been quite well during her pregnancy but following delivery she had felt a little breathless.

Clinical examination on re-admission showed similar findings to those of her previous admission with, in addition, the appearance of a few crepitations in the left side of her chest. X-ray at this time showed no change in the X-ray picture of her chest.

20.9.49. Operation - Mr. Dick, Mr. Fraser.

Dr. Robson -
Pentothal,
Cyclopropane.

The chest was opened by a left postero-lateral incision. The lung was found to be free. A large cystic mass was seen lying anteriorly in the chest and extending from diaphragm to subclavian vessels. It was in intimate contact with the pericardium, lung and left pulmonary veins. The cyst was opened and its thick yellowish contents were allowed to escape and were removed. These contained several strands of detached blonde hair. The cyst wall was then dissected off and the lung was excised. The portion adherent to pericardium could not be separated from

the pericardium and it required excision of both wall and pericardial sac over this area. The core of the cyst was of firm consistency and was situated at the superior end of the cyst. It was removed as far as possible and was found to contain a tooth. The only portion of the cyst wall which could not be removed measured about 2" square and was in contact with the subclavian vessels.

Penicillin-sulphathiazole powder was then applied to the raw area and the chest was closed with a de pezzer catheter and instillation of penicillin.

21.9.49. Her condition was satisfactory.

22.9.49. Pathology Report, Royal College of Physicians, No.9953/4785, Dr. Lees. "There were parts of a cyst wall. The outer surface of the wall appeared to be smooth, but the inner surface was roughened. In the wall of the cyst there appeared two small areas of cartilage and areas of calcification. The second portion of tissue had one surface covered with what looked like skin, and from the other surfaces there projected a small papillary nodule.

Histological examination. The wall of the cyst

is formed of dense hyalinised acellular connective tissue into which haemorrhage has occurred and which contains areas of calcification. There is, in fact, no cartilage. The papillary nodule has been, in fact, the mamilla of the dermoid cyst. It is covered by skin (squamous epithelium) and in the corium lie numerous sweat and sebaceous glands. Beneath the corium there is some fat. The only other type of tissue seen, other than skin and its appendages, is a small group of tortuous gland-like structures lined by multi-layered columnar mucous secreting epithelium of ? respiratory type. There is no malignancy.

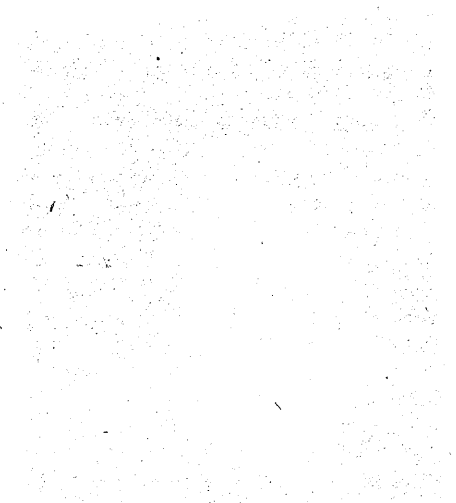
Diagnosis: Benign Teratoma, Dermoid cyst".

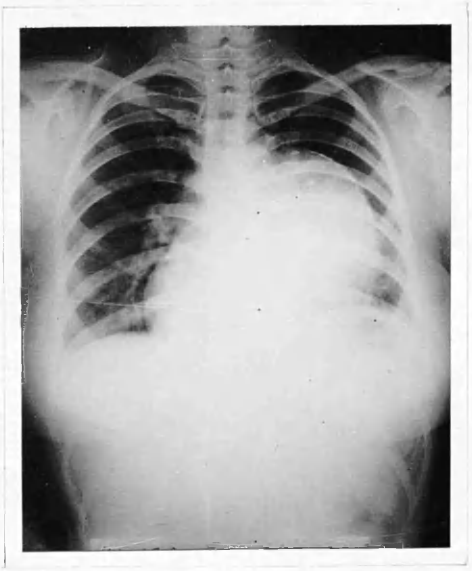
26.9.49. She had been running a temperature for some days and was collecting fluid in her chest which required aspiration.

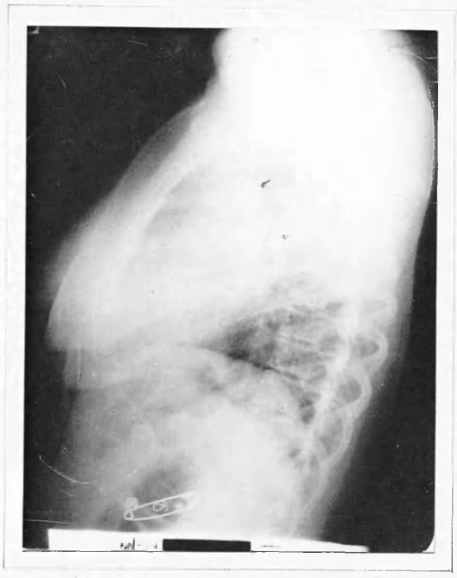
1.10.49. She developed a moderate phlebitis of the right leg. This disappeared rapidly.

6.10.49. She complained of swelling in the left leg and knee. The left leg was swollen and discoloured and it was thought that she had a deep

thrombosis and was put on to heparin therapy. The lung was slow to re-expand but this ultimately occurred and the swelling of her leg disappeared and she was allowed home on 5.11.49, when her condition was satisfactory.







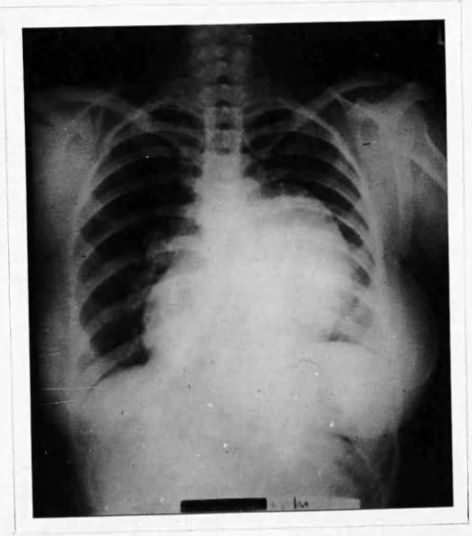
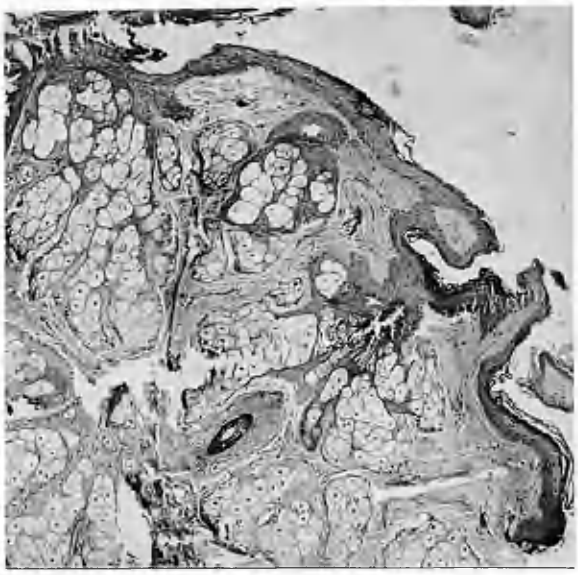
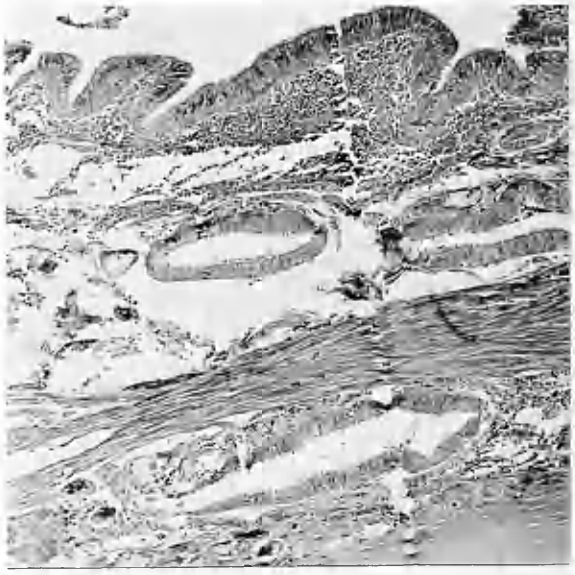
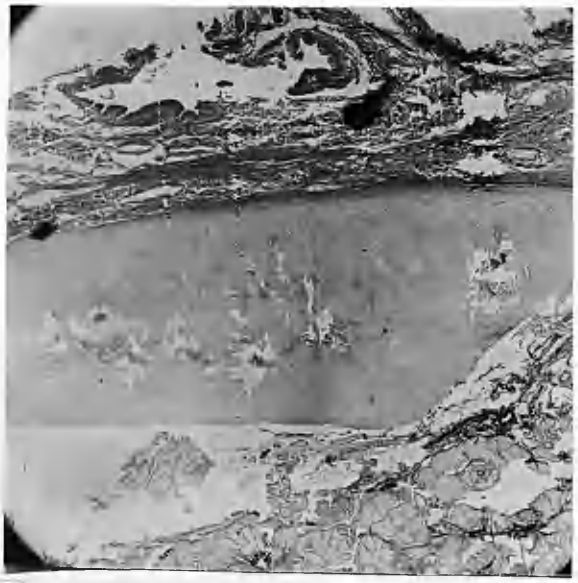


Fig. No. 47. X-ray films showing the dermoid cyst in the left chest. The mediastinum is displaced to the right and the trachea is displaced posteriorly. A thin rim of calcification can be seen in the cyst wall.







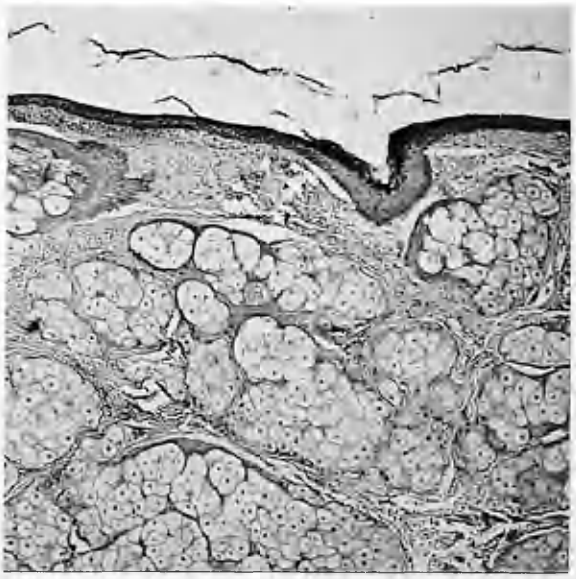


Fig. No. 48. Representative sections showing squamous and columnar epithelium, cartilage, sebaceous glands and muscle fibres.

Case No.16.

W.S. (40). Occupation - Railway Signalman.

Admitted 26.2.49,

Dismissed 19.3.49.

Diagnosis Dermoid cyst of mediastinum.

History. He had had no serious illnesses in his life. Four months prior to admission while having lunch he complained of a sudden pain in the middle of the lumbar region, which caused him to stiffen up. This pain did not radiate. He then walked one mile to his work but was unable to do any work. His own doctor diagnosed ? displaced intervertebral disc and after a fortnight in bed his pain improved and he was sent to Bridge of Earn Hospital for an X-ray of his spine. While he was being examined it was noticed that his fingers were clubbed and an X-ray of his chest was taken. A shadow was then discovered in the left lung which, when screened, was thought to be a pulsating aneurysm. He was sent to Mr. Dick who advised operation. He worked until the day of admission. There was no cough or spit, no breathlessness and no pain in his chest. There was no difficulty in swallowing

and no hoarseness. His appetite had been good and there was no loss of weight.

There was no upset of micturition.

General Examination. General condition was fair and he was of good colour. There were no glands in his neck or axilla and no congestion of neck veins. The trachea was in the mid-line. There was slight clubbing of his fingers, no cyanosis and no superficial swelling.

Respiratory system. The movement of his chest was symmetrical and of good extent. The percussion note was resonant throughout posteriorly. There was slight impairment of percussion in the left mid-zone anteriorly. Respiratory murmur was vesicular throughout and free of adventitious sounds. Vocal resonance and vocal fremitus were equal on the two sides.

Cardiovascular system)
Alimentary system) No abnormality. B.P. 140/80.
Genito-urinary system)

28.2.49. X-ray Report, Dr. McKail. "There is a well defined smooth-walled mass of homogeneous opacity about 12 cms. in diameter in the anterior mediastinum. The main mass of the tumour lies behind the 3rd, 4th and 5th left costal cartilages but it also projects

to the right of the spine to a lesser extent. Appearances are those of a dermoid cyst".

1.3.49. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Cyclopropane,
Curare.

The left hemithorax was opened through the bed of the resected 6th rib. The lung was free of adhesions and the dermoid was immediately felt beneath the mediastinal pleura lying below the left pulmonary artery. The mediastinal pleura was incised and the dermoid easily enucleated. There was a tiny pedicle of attachment to the pulmonary artery. There was a general ooze of blood from the bed of its removal, situated somewhere in the region of the left pulmonary artery and inferior to the arch of the aorta. A pack was inserted into this area and the chest was closed with an intercostal drain.

The dermoid was an oval structure 4 x 3 cms. and bars of cartilage could be felt in it. The lingula lobe in this case formed a separate lobe and was of marked attenuation.

1 in 1,000 procaine and blood were administered intravenously during the operation.

Pathological Report, Mr. K. Fraser. "This is a yellowish white tumour 12 x 9 cms. in size. On section several small cysts are seen and are mainly confined to one half of the tumour. The largest of these cysts was blue-domed and measured 4.5 x 3 cms. There are areas of bone formation of small size scattered throughout the tumour".

3.3.49. Pathological Report, Royal College of Physicians, No.6654/1243, Dr. Wallace Park. "There was a fragment of fat which was mainly a blood clot mass. On section this mass, which was seen to consist of a thin outer shell with what looked like bone in the centre of which there appeared to be blood, portions of what looked like fibrous tissue were separated from the outer surface of the bone in the hope of being able to give a quick report, but the essential tumour nodule appeared to be entirely bony and this part was placed in solution for decalcification. To the naked eye there did not appear to be any evidence whatever of malignancy."

Histology Report.

1. Small particles of fat and fibrous tissue strands, occasional small arteries and capillaries.

2. No evidence of any tumour tissue.

Further report of decalcified section:-
There is a rim of cancellous and structurally normal bone surrounding red marrow which is apparently haemopoietic. There is also a thin cancellous framework of bone lying among this red marrow. There is a fibrous capsule to the bone - periosteum - and outside that there is fat.

I can only record the fact that there is a nodule of heterotopic cancellous bone and can have no opinion as to how it has formed".

2.3.49. X-ray Report, Dr. McKail. "Left thoracotomy. The lung is almost completely expanded. There is a small effusion".

3.3.49. The pack was removed.

10.3.49. General condition was greatly improved.

19.3.49. Patient was discharged home.

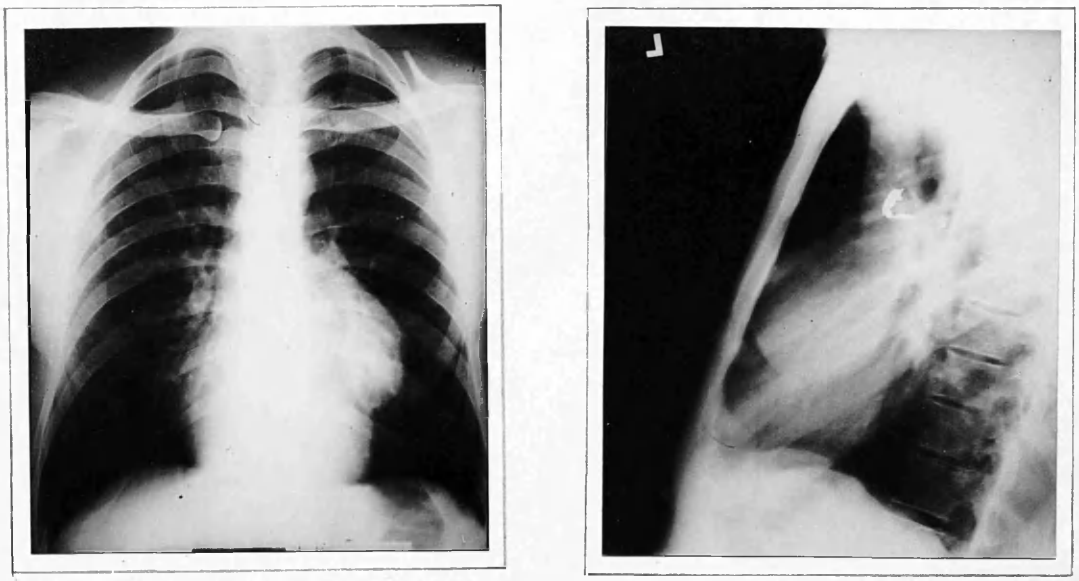


Fig. No. 49. Dermoid cyst lying in the left anterior mediastinum. The cyst was attached to the left pulmonary artery.

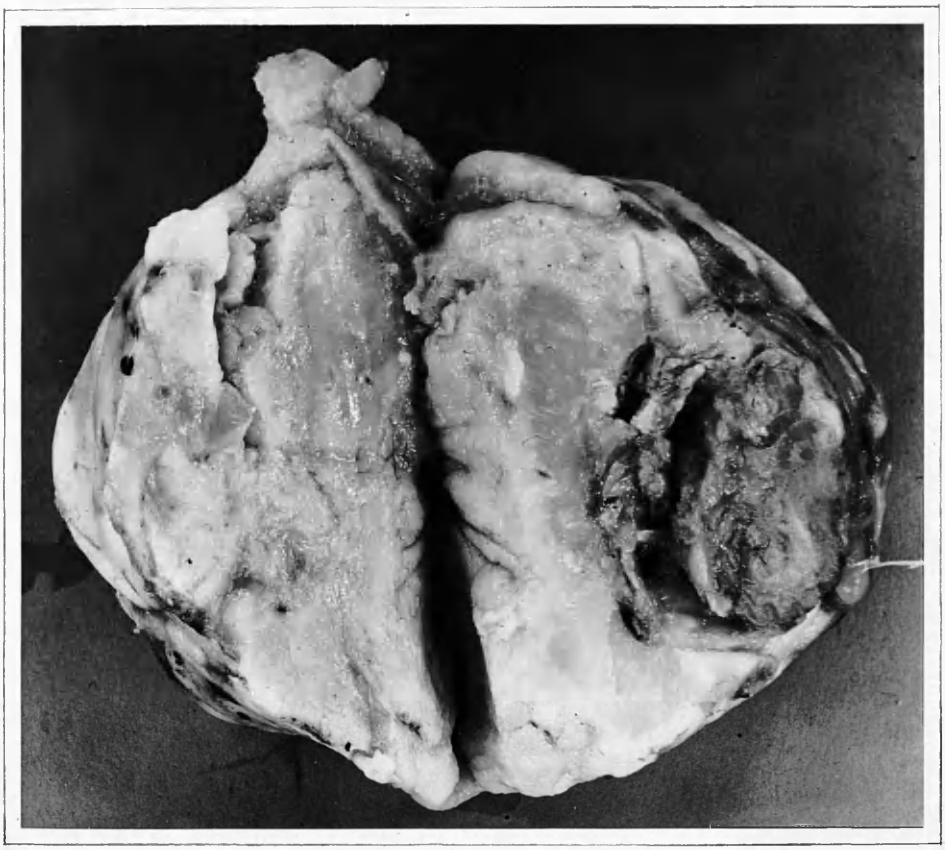
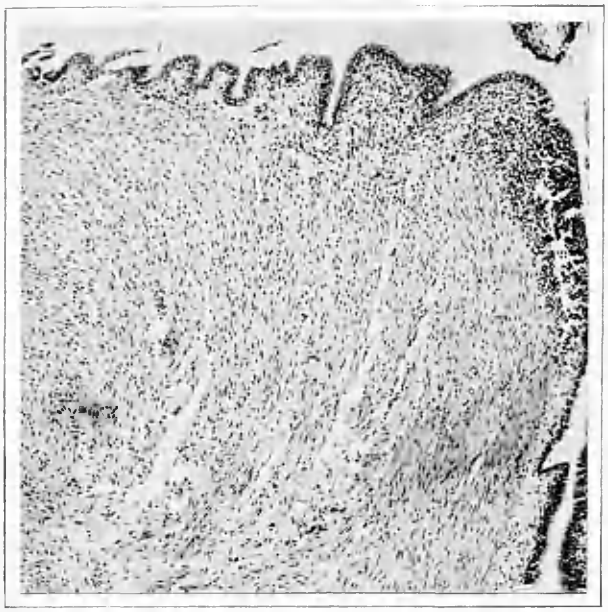
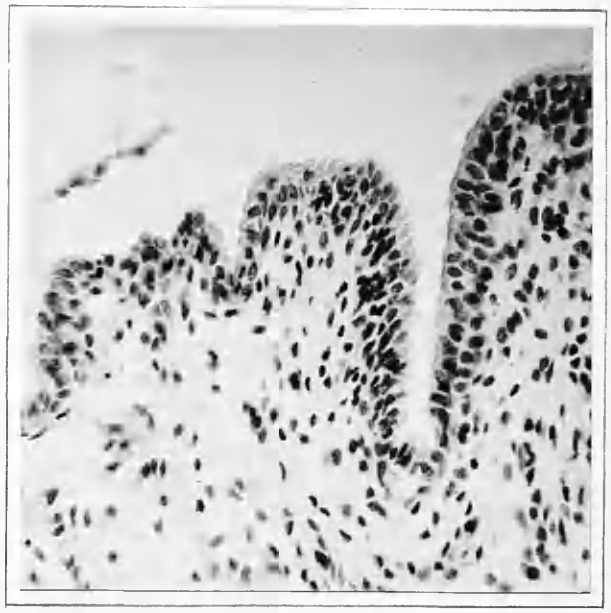


Fig. No. 50. Cut section of the dermoid. The larger cyst is seen at 3 o'clock on the specimen.





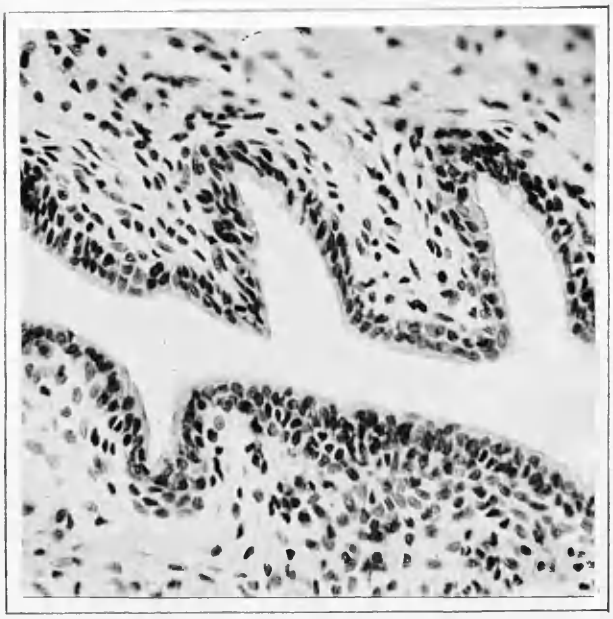


Fig. No. 51. Photomicrographs taken from the main specimen (preserved by myself and not from tissue reported on by the Royal College of Physicians) showing slit-like spaces lined by epithelium several layers thick.

Case No. 17.

R. McC. (36). Occupation - Housewife.

Admitted 14.2.48, 17.5.48,

Dismissed 26.4.48. 17.7.48.

Diagnosis. Mediastinal Dermoid.

History. In December 1947, she had had a cold with cough, following which she developed pain in the left side of her chest anteriorly and posteriorly. Later this pain radiated down the left arm. The pain was constant and was unrelated to exercise. The muscles of the left side of her chest were tender to pressure and 3 weeks prior to admission she noticed swelling of the left anterior aspect of her chest. With the appearance of the swelling the pain disappeared. She had only a slight cough at this stage and her sputum which had been copious and brown to begin with had now ceased. She was somewhat breathless on exertion. The lump did not increase in size since it was first noticed.

Examination. She was a healthy well built woman. There was no cyanosis or clubbing of the fingers.

Respiratory system. There was a rounded mass visible on the anterior aspect of the left chest which

extended from the 2nd costal cartilage down to the 4th costal cartilage. It gave the impression of merging into a softer swelling in the left breast. The left breast was one inch higher than the right. There were no palpable glands in the axilla or in the neck. The percussion note over the swelling was dull but not stony dull. The respiratory murmur was distant but otherwise normal. The swelling was not tender to touch. Abduction of the left arm caused pain beyond 80°.

Cardio-vascular system. No abnormality.

16.2.48. X-ray Report, Dr. McKail. "A well defined opacity of homogeneous density 10 x 7 cms. is seen in the upper part of the anterior mediastinum projecting into the left lung. Its margins are fairly well defined and an incomplete rim of calcification is seen just within its outer border. The anterior end of the second left rib is displaced downwards. A more irregular opacity is seen extending from the main mass into the left lung and a soft tissue projection is seen on the anterior chest wall. The swelling exhibits a transmitted pulsation. The appearances are probably due to a dermoid cyst".

19.2.48. The left forearm was found to be slightly thinner than the right but muscle power was good and equal on the two sides.

B.P. on the right side 128/76,

B.P. on the left side 127/72.

The swelling was aspirated and a few c.c. of thick yellow purulent material was obtained with difficulty.

23.2.48. Under local anaesthesia the swelling was explored and thin pus with lumps of caseous material removed from a cyst-like cavity in the superficial tissues.

24.2.48. Royal College of Physicians Report.

"1. There is a mass of cells, some fibroblastic in appearance many xanthomatoid with a granular but not vacuolated cytoplasm. There are scattered cholesterol crystals and also non-classified debris with a foreign body giant cell reaction.

2. The question is: Is this a neoplasm or a tumour like reaction to an inflammation, e.g. an encysted empyema? I think with fair certainty that it is not neoplastic and still more, that it is not malignant. There is nothing to suggest tuberculosis specifically. In my opinion,

therefore, this is a manifestation of a chronic inflammatory reaction of some kind and as far as this tissue goes is not specific.
Examination of the pus showed no tubercle bacilli and no organisms were found".

26.4.48. The wound remained open for some time but she was discharged. Mr. Dick has said the diagnosis was probably aneurysm of the aorta and that thoracotomy was not justified.

20.5.48. X-ray Report, Dr. McKail. "Compared with films of 9.3.48, appearances remain unchanged apart from the disappearance of the soft tissue swelling on the chest wall.

A review of the series of films suggests that the mediastinal mass is most probably due to an aneurysm arising from the left posterior sinus of Valsalva".

18.5.48. Re-admitted. Sinus still discharging.

25.5.48. Operation - Mr. Fraser. Dr. Pinkerton - Pentothal.

An incision was made over the side of the sinus and the track was followed and led into a smooth cyst-like space lying just below the upper and inner quadrant of the breast. A good deal

of thick cheesy pus was removed. The costal cartilage appeared healthy. The track then appeared to pass deep to the sternum. The costal cartilage was then divided and in attempting further dissection the internal mammary artery was divided and bleeding was controlled with some difficulty. A gauze pack was then inserted and the wound was closed around a large drainage tube.

25.5.48. Pathological Report, Royal College of Physicians, No.1974/3156, Dr. Barnard.

"1. Chronic inflammatory reaction.

2. Young celled fibrous tissue containing plasma cells, lymphocytes, numerous eosinophils and a variety of cells of foreign body type. In addition there are cholesterol clefts and numerous lipophages. Fat appears to be implicated in the inflammatory reaction.

3. There are no tuberculous follicles, and histologically this is not a tuberculous lesion. If the material came from bone one would have considered the eosinophil granuloma, to which this lesion is not dissimilar apart from the obvious inflammatory reaction.

I am unable to say what special significance, if any, is to be attached to the eosinophils and lipophages".

14.6.48. X-ray Report, Dr. McKail. "Compared with film of 25.5.48, the mediastinal mass shows some reduction in size and the rim of calcification is now somewhat crenated. This would suggest that the original diagnosis of cyst is probably correct".

2.7.48. Operation - Mr. Dick. Dr. Pinkerton - Pentothal, Cyclopropane, Tubarine.

The chest was opened by the usual postero-lateral incision. The lung was free of adhesions. The mediastinal mass was easily seen and on palpation was firm and at first suggested aneurysm. It was aspirated and pus was obtained.

The cyst was anterior to the ascending aorta and was in close relationship to the pulmonary artery and the left auricle. When further aspiration was about to be performed the cyst ruptured and purulent material with flecks of inspissated pultaceous material were extruded. The mass was carefully dissected out from the aorta. A large part of the cyst wall was removed and was found to be calcified. Further portions of the cyst were then removed piecemeal.

The cyst was seen to lie between the aorta and the pulmonary artery in the antero-lateral aspect corresponding closely to the site of the ductus arteriosus. Only a small portion of the cyst had to be left behind.

Penicillin and sulphonamide powder were dusted into the wound which was then closed without drainage.

6.7.48. Royal College of Physicians Report, No.2616/3963/4, Dr. Barnard. "1. The cyst wall is composed of laminated fibrous tissue, hyaline in parts and containing calcific deposits. It is infiltrated with round cells and there are one or two giant cells of foreign body type.

2. There is no sign of neoplasm in the sections. Whether the cyst has developed from a vestigal remnant, whether it is a sterile encysted empyema or developed on the basis of a teratoma or some other tumour is impossible to say. There is no epithelium to provide a clue in this matter. There is no evidence of tuberculosis. The content is amorphous. There is nothing to suggest a malignant condition as far as this examination is concerned.".

3.7.48. Condition was very satisfactory.

16.7.48. Improvement was maintained; the sinus in the front of the chest had stopped discharging.

17.7.48. Patient was discharged.

21.9.48. Patient reported today. She was very well, gaining weight and free from symptoms.

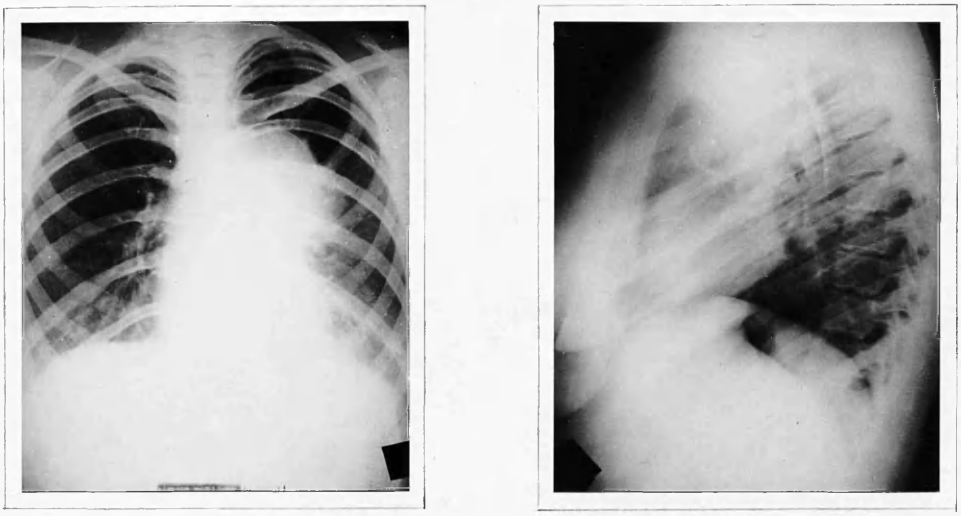


Fig. No. 52. An infected dermoid cyst is responsible for the rounded shadow seen in the left anterior chest. At operation it was found to be between and antero-lateral to the aorta, the pulmonary artery and the left auricle.

Case No. 18.

A. McL. (40). Occupation - Housewife.

Admitted 13.8.48,

Dismissed 10.10.48.

Diagnosis Congenital cyst of right lung.

History. She first noticed a feeling of tiredness twelve weeks prior to admission, then she became conscious of a peculiar sick feeling in her stomach and chest. Twenty four hours later she developed a violent bout of coughing which terminated in the expectoration of half a pint of rather dark red blood. The following week she continued to have streaks of blood in her sputum. She then consulted her own doctor, who had her chest X-rayed and transferred her to Bridge of Earn hospital. She felt tired, and vaguely unwell. While in Bridge of Earn, she continued to have a slight cough and an ounce or two of yellow frothy sputum in the 24 hours. She had a 10 day course of penicillin and sulphanilamide therapy. She had no further symptoms.

Previous Health. She had a right sided empyema when she was 12 years of age following upon pneumonia.

Examination. She was a well built healthy looking

woman. There was no cyanosis, no clubbing of the fingers and no palpable enlarged glands.

18.8.48. X-ray Report, Dr. McKail. "There is an area of homogeneous density with a large cavity showing a fluid level in the axillary portion of the apical segment of the lower lobe of the right lung. The appearances are those of a pulmonary abscess."

2.9.48. X-ray Report, Dr. McKail. "The bronchi of the right lung have been outlined with lipiodol. The abscess seems to lie in the middle basal segment of the lower lobe of the right lung. It has caused displacement of the neighbouring bronchi. The middle lobe bronchi show evidence of bronchiectasis."

6.9.48. She had progressed quite well but there were still crepitations posteriorly in the right lung which were constant and persistent. She produced variable amounts of sputum in the mornings, on turning over.

15.9.48. Bronchoscopy, Dr. Semple. "Trachea, carina and both stem bronchi normal. All orifices of the right bronchus visualised and normal. No discharge from apical segment of right lower lobe.

17.9.48. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Curare,
Cyclopropane.

The chest was opened by the usual right postero-lateral incision. The right lower lobe was found grossly adherent to the diaphragm and a superficial non-smelling pus-containing cavity was broken into. The vein to the lower lobe was dissected out, ligated and divided. The remainder of the structures to the lower lobe were caught by transfixing ligatures. Penicillin-sulphathiazole powder was instilled; a de pezzer catheter was inserted and the chest was closed.

18.9.48. Her condition was satisfactory and the lung was buoyant.

Pathological Report, Mr. K. Fraser. "The lobe was cut open and laid flat, to reveal a smooth lined cyst 7 x 5 cms. in diameter, showing in one area punctate haemorrhages. Peripherally, the lung shows a slightly translucent almost gelatinous appearance due ? to emphysema".

22.9.48. Royal College of Physicians Laboratory, (No.3756/5252), Dr. Lees. "1. The cyst is lined

by respiratory ciliated pseudo-stratified epithelium which in places is eroded and ulcerated. There are numerous gland like diverticula from it. These are lined by high columnar entodermal epithelium.

2. There is a good deal of fibrosis and chronic inflammatory cell infiltration round the cyst.

3. The appearance is that to be expected in a congenital cyst. What the relation might be of this cyst, in particular appearing at this age, to bronchiectasis is another matter.

4. The inflammatory cell reaction is obviously secondary. This is not an abscess".

2.10.48. She was making good progress.

10.10.48. Wound was soundly healed and she was gaining strength and had no sputum. Patient discharged.

10.11.48. Patient reported on this date. She now had no symptoms, no cough or spit. Examination revealed some crepitations posteriorly at the right base.

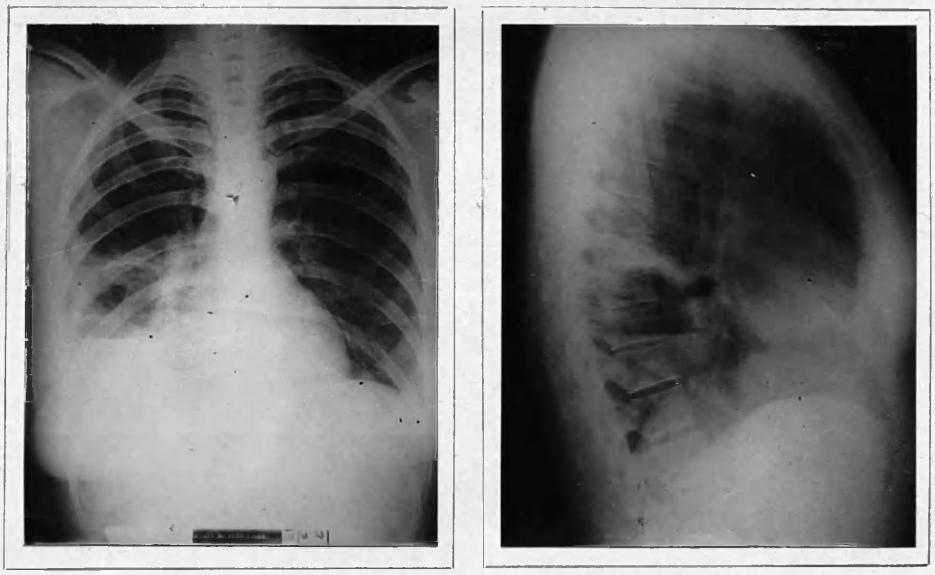


Fig. No. 53. X-ray films showing the lung cyst in the apex of the right lower lobe. There is a fluid level within the cavity.

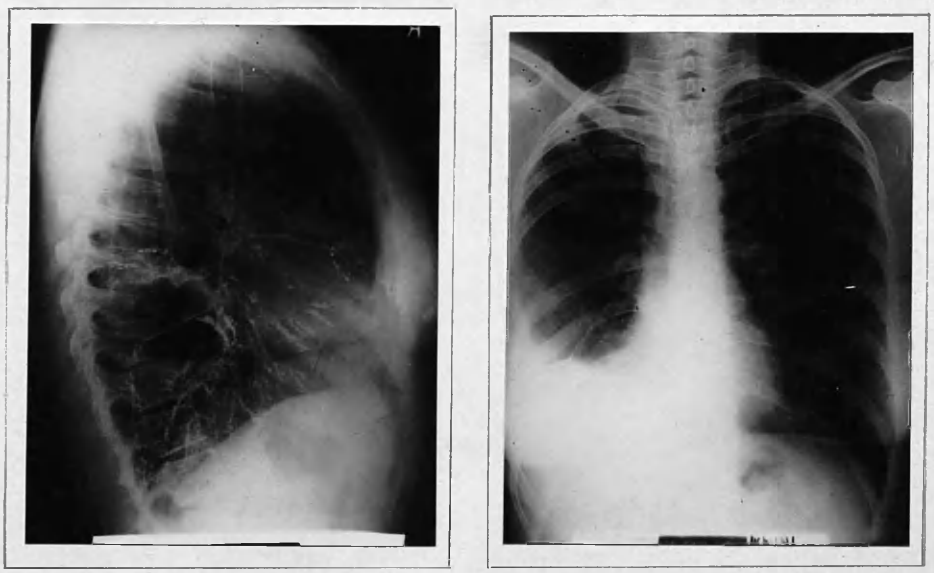


Fig. No. 54. The picture on the left is a lateral X-ray of the bronchogram; little if any lipiodol seems to have entered the cyst. The X-ray film on the right shows the post-operative appearance; the lung is practically fully re-expanded.

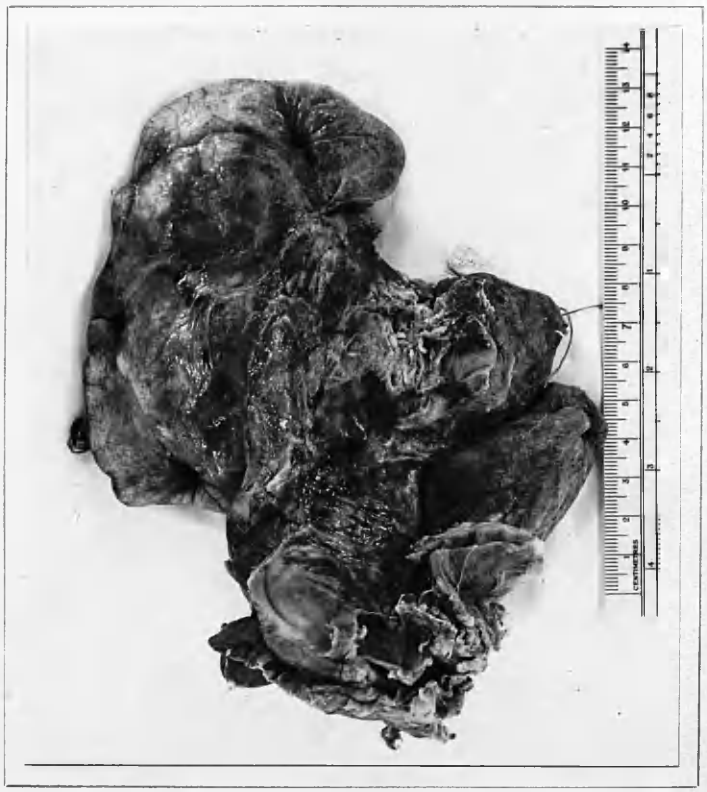
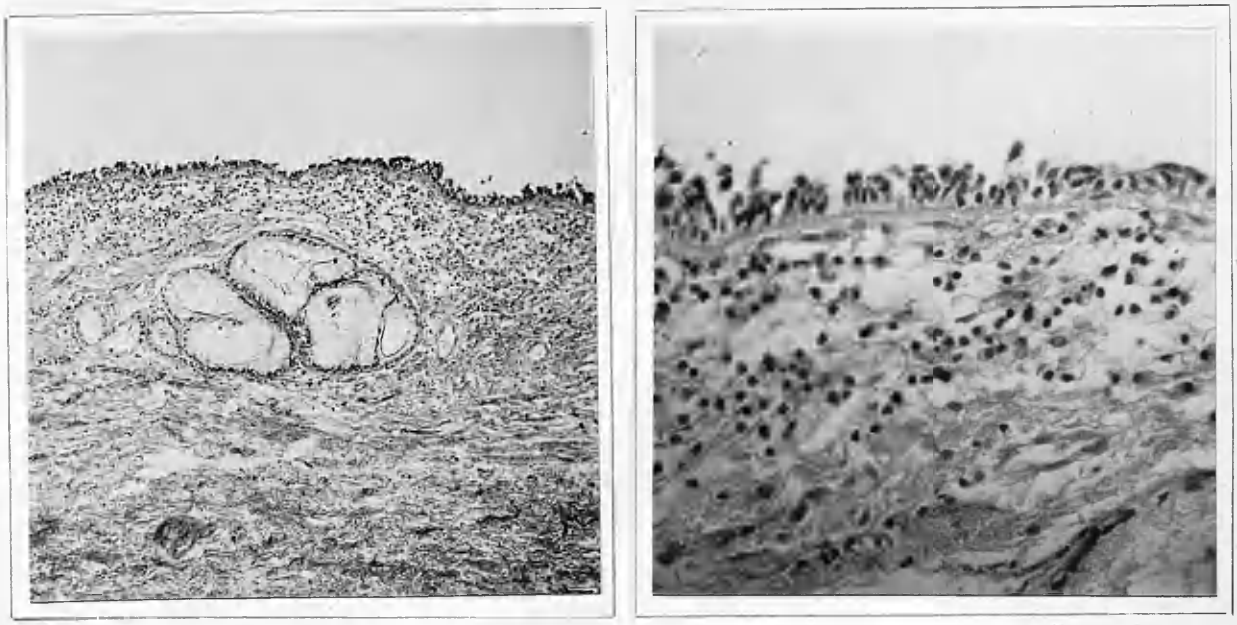


Fig. No. 55. The preserved lobe. The cyst lies at the apex of the lobe. The lower edge of the lobe is below and also to the right.



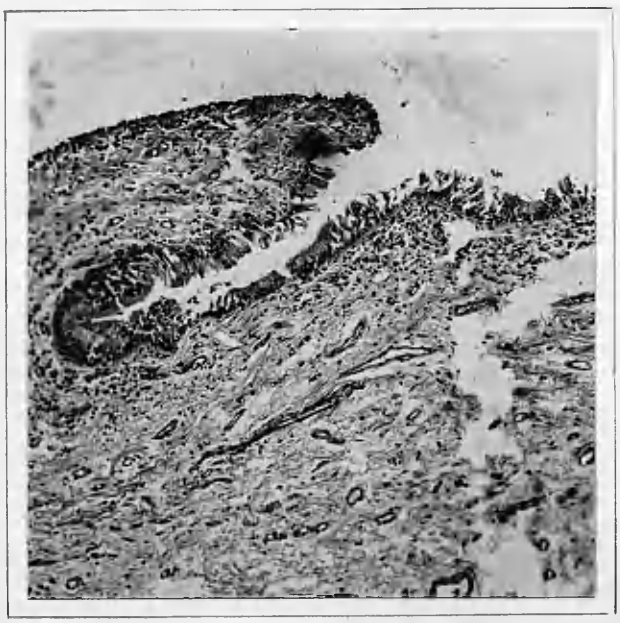


Fig. No.56. Cyst wall lined by ciliated pseudo-stratified epithelium. In places it is eroded and ulcerated.

Case No.19.

M.S. (5).

Admitted 26.5.48,

Dismissed 23.6.48.

Diagnosis Bronchial cyst of lung.

History. The patient could not give a reliable history. Apparently she had had a pneumonia-like illness when admitted to Bridge of Earn several months previously. She was treated on the usual lines and her temperature settled. Fluid was noted in the lower left chest after onset of the illness.

General examination. She was found to be of average height for her age and well nourished. Her mucous membrane were well coloured. There was no clubbing of the fingers and no cyanosis.

Alimentary system. No abnormality.

Respiratory system. The chest was well formed and there was no obvious impairment to percussion. The respiratory murmur was vesicular throughout but greatly diminished in intensity at the left base and in the left axilla. No adventitiae were heard.

Cardio-vascular system. There was a soft, short diastolic murmur at the mitral area.

27.5.48. X-ray Report, Dr. McKail. "Thin-walled air containing cyst some 10 x 8 cms. in diameter seen occupying the lower and posterior part of the left hemithorax. There is some displacement of the heart to the right and there is a little pleural thickening in the left chest wall. Reference to films of 8.1.48 indicate that the cyst contained fluid at this period and was possibly somewhat similar.

Appearances suggest a congenital cyst of bronchogenic origin which is connected with the bronchus and thus evacuated its contents".

4.6.48. Operation - Mr. Dick, Mr. Fraser.
Dr. Pinkerton -
Pentothal,
Cyclopropane.

The chest was opened by a postero-lateral incision. A large distended cyst was seen as soon as the chest was opened. A few adhesions were attached over the upper lobe. During manipulation the cyst deflated spontaneously.

Lobectomy for removal of the cyst was carried out and the wound was closed after instillation of penicillin, the chest being drained.

6.6.48. The tube was removed. The lung had re-expanded to a well marked extent.

8.6.48. She was allowed up and was moving about.

Pathological Report, Mr. K. Fraser. "The lower lobe of the lung is almost completely replaced by a cyst 11 x 6.5 cms. The cyst is thin walled, and is 1 millimetre in diameter, except where the remnant of lung on the medial side is lying. The lining is smooth and shiny towards the foot of the cyst, where there are several vascular cord like strands running across the cyst like the attachment of heart valves. Some of these run only a short distance, while others run completely across the cyst. These bands have a columnar cell covering several layers thick. Within the core of these bands there are quite a number of tiny cystic spaces of varying size; these are in the main covered by cubical or columnar epithelium. Some of these cysts are compressed into slit like spaces".

14.6.48. X-ray Report, Dr. McKail. "The lung is completely expanded. There is some pleural thickening at the costo-phrenic angles".

23.6.48. She was dismissed.

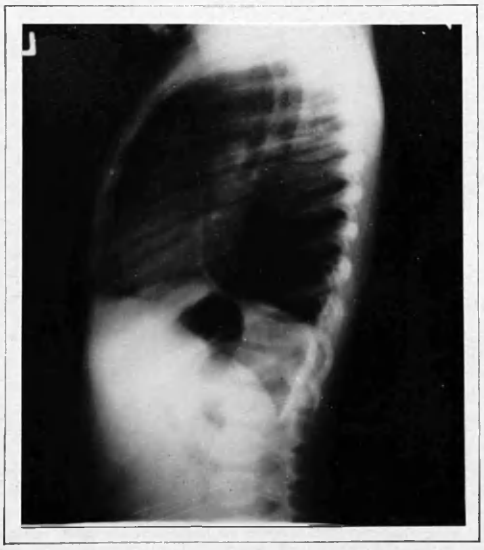


Fig. No. 57. Lateral X-ray film showing the thin-walled, air-filled cyst in the left lower lobe.

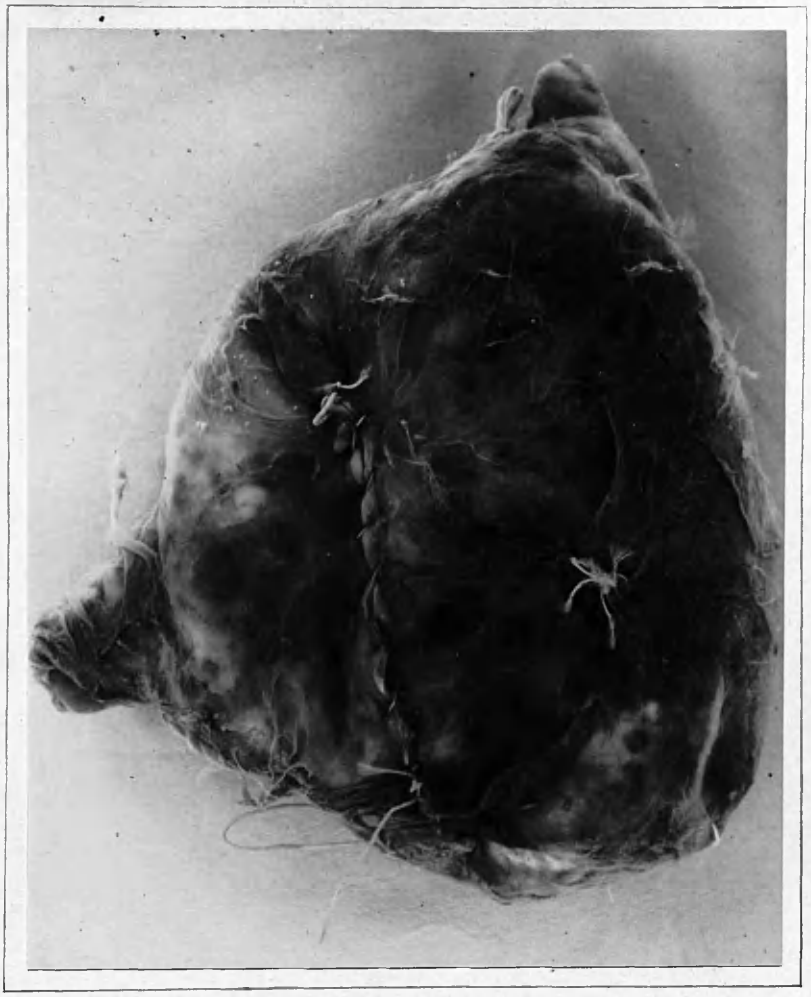
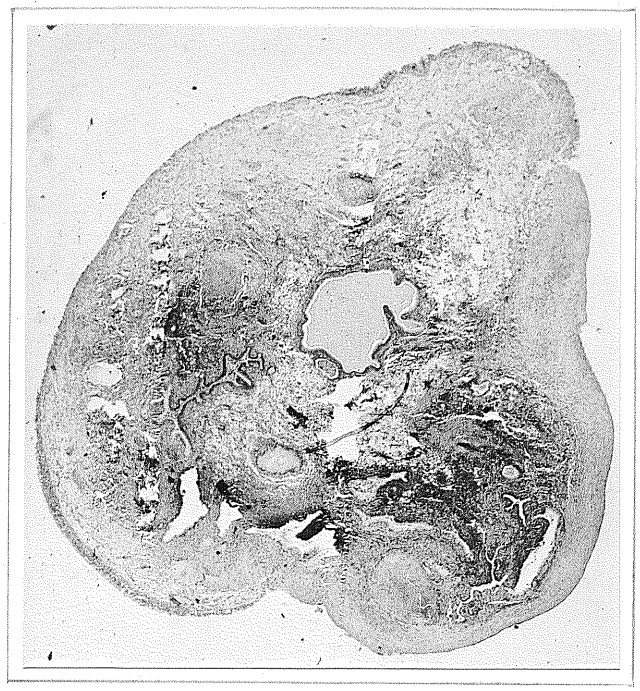
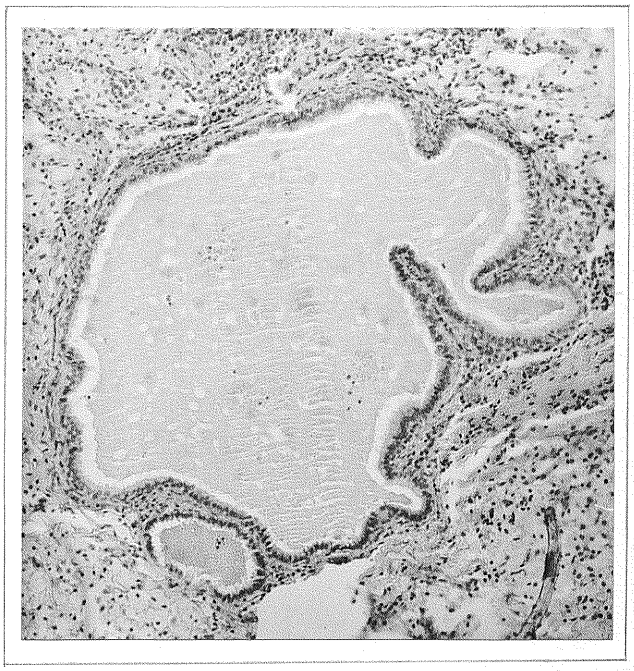
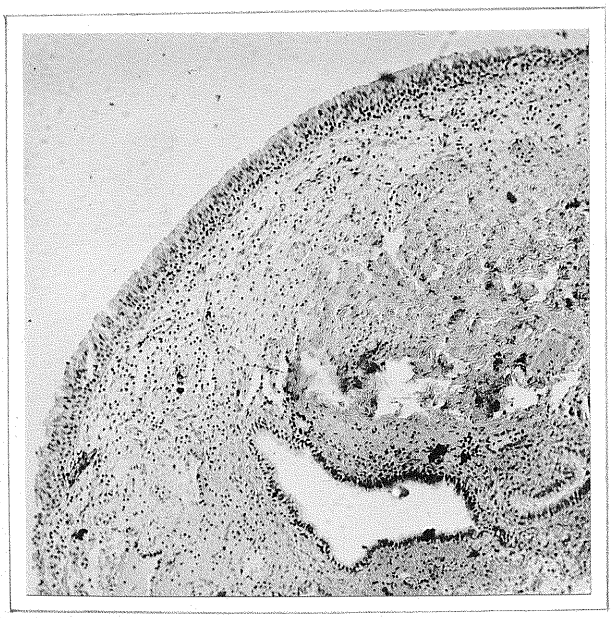


Fig. No. 58. The left lower lobe is almost completely replaced by the cyst.

Fig. No.59. The cyst opened. Note the strands of tissue traversing the cyst; also the very thin cyst wall.







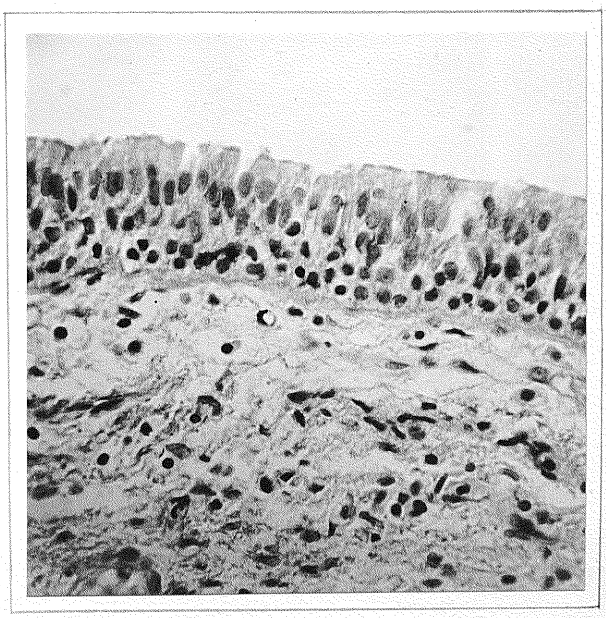


Fig. No. 60. Cross section of one of the strands traversing the cyst. The strand has a lining of columnar epithelium; the contained spaces also have an epithelial lining.

Case No. 20.

J.M. (24). Occupation - Merchant Seaman.

Admitted 25.1.44,

Dismissed 11.3.44.

Diagnosis Bronchogenic cyst.

History. On admission, apart from a slight cough accompanied by grey sputum he felt remarkably well but occasionally had had twinges of pain across his chest during the month prior to admission. There had been no breathlessness on exertion and no loss of weight.

He was told that he had a tumour in his chest when he was examined by the Navy.

Bowel and bladder habit were normal.

Previous health. Apart from bronchitis he had had no serious illness.

Family history. Father died at 45 from carcinoma of throat. Mother and another brother are healthy.

Examination. He lay comfortably in bed and had a healthy appearance although he was somewhat pale. There were no enlarged glands, no cyanosis and no clubbing of the fingers.

Respiratory system. The chest was symmetrical

and there was slight diminution of movement on the left side. The vocal fremitus and vocal resonance were normal. Percussion note at the left apex was impaired. Respiratory murmur was slightly increased in the right upper zone and there was slight diminution at the left apex. Sibilant rhonchi were scattered throughout both lungs.

Alimentary system. Tenderness in right iliac fossa but no other abnormality.

Cardio-vascular system. No abnormality.

Blood pressure 125/70.

Blood count - Haemoglobin 85%, R.B.C. 4,520,000, W.B.C. 9,200. Blood film showed no abnormality.

1.2.44. Operation - Mr. Dick, Mr. Fraser,
Dr. Pinkerton -
Pentothal,
Cyclopropane.

An incision was made in the 2nd left interspace and the intercostal muscle was divided. The costal cartilages above and below were divided. A lobulated spherical greyish white tumour 7 x 6.5 cm. was found lying on the mediastinal border of the upper lobe of the left lung. The tumour was attached to the mediastinum by a pedicle

.5 cms. in diameter. Transmitted pulsation was seen through this pedicle going through the pulmonary artery to the upper lobe; the superior mediastinal aspect of the pedicle lay in contact with the summit of the aortic arch to which it was lightly adherent.

A few small glands were found in the pedicle and were not removed for fear of haemorrhage. The pericardial sac was opened into in order to free the pedicle but there were no adhesions to the left auricle. The pedicle was gradually freed by blunt dissection and was eventually tied; all the tumour was removed. The wound was closed.

Pathological Report, Mr. K. Fraser. "The specimen is a greyish white lobulated tumour, slightly oval, and 7 cm. x 6 cm. in size. It felt partly solid and partly cystic. On section it was found to be almost entirely cystic with an area 3 cm. in diameter of thin umbilicated white tissue, cartilaginous in consistency. The content throughout was greenish yellow in colour and of a musty odour".

Histological Report, Mr. K. Fraser. "This is a very interesting tumour. One plaque shows a cystic space lined by well formed columnar epithelium

which has well developed cilia. In the cyst wall there is cartilage which corresponds in appearance to bronchial cartilage. Numerous scattered glands are present with here and there areas of lymphoid tissue.

The second plaque shows the above features with in addition cells resembling poorly developed pulmonary tissue, not foetal in type. Numerous large pale phagocytic cells are seen and are filled with fat.

Dr. Lendrum suggests that this unusual tumour is a form of agenesia of bronchus, that is, bronchus and part of lung which has failed to develop".

4.3.44. He had been up and about now for several days, was very well and showed no upset.

11.3.44. Very well. He went home.

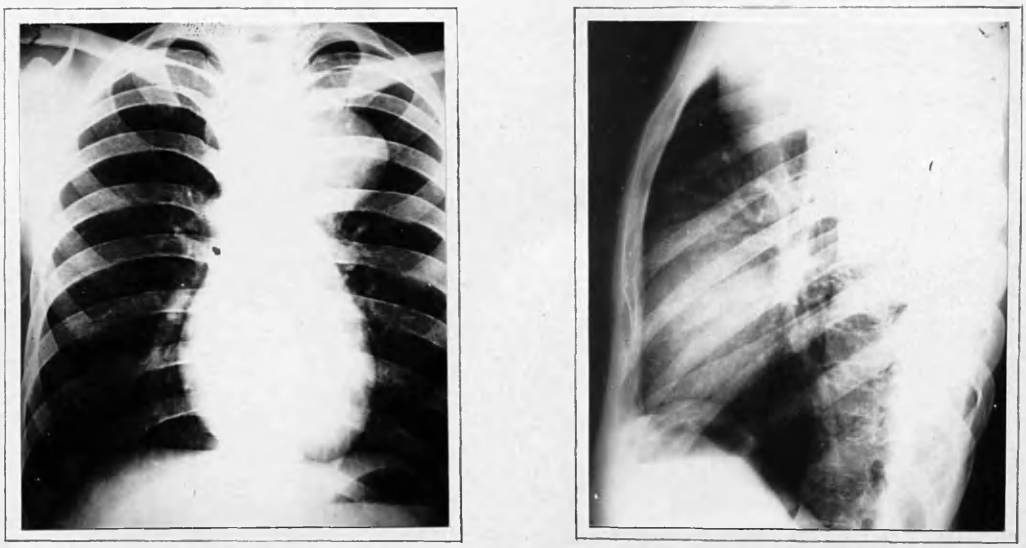


Fig. No. 61. The bronchogenic cyst is seen lying on the medial aspect of the left upper lobe.

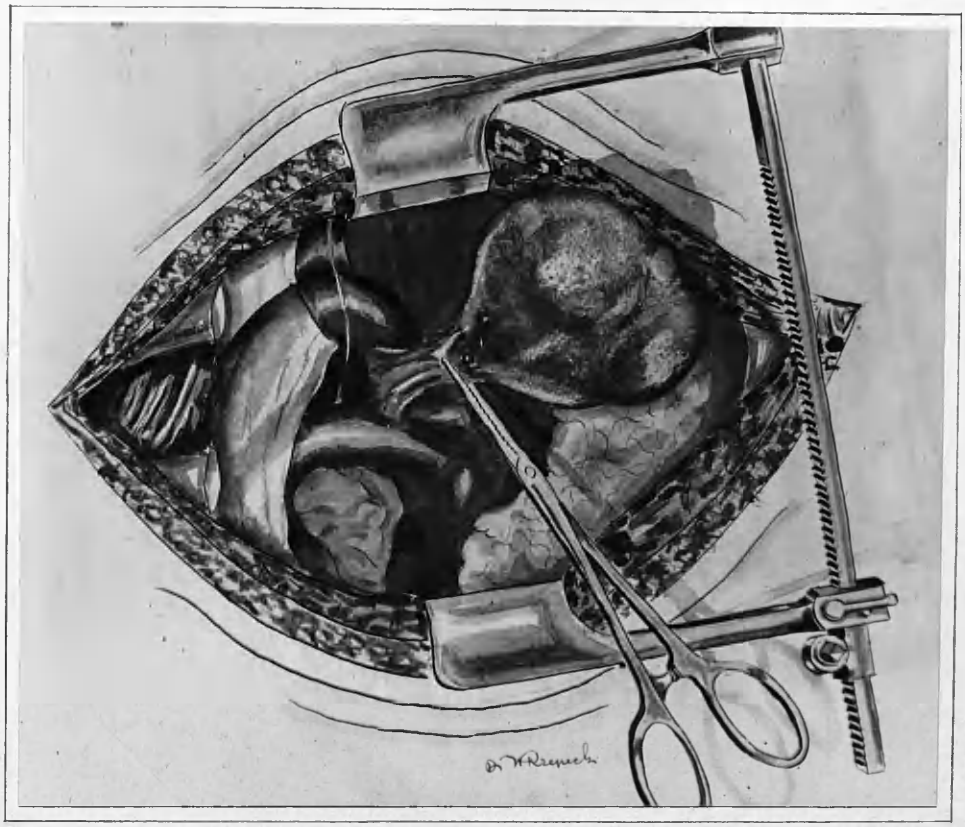


Fig. No. 62. A drawing made at the operation when the cyst had been freed and the pedicle of attachment to the arch of the aorta had been clamped.

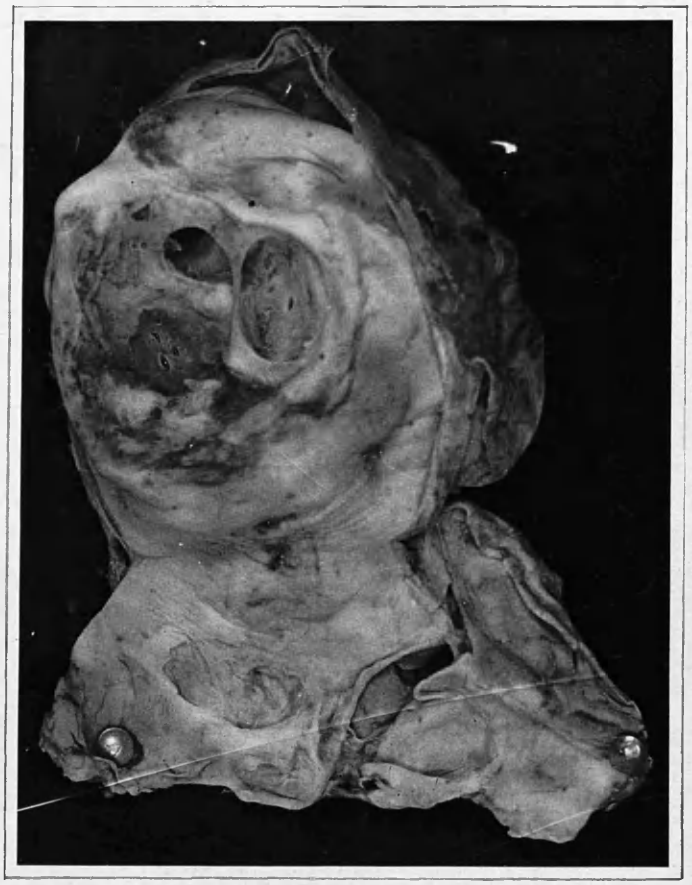


Fig. No. 63. The preserved specimen. The cyst has been opened and the wall of the cyst is turned back to show the thicker area of cyst wall in which are several smaller cystic spaces.

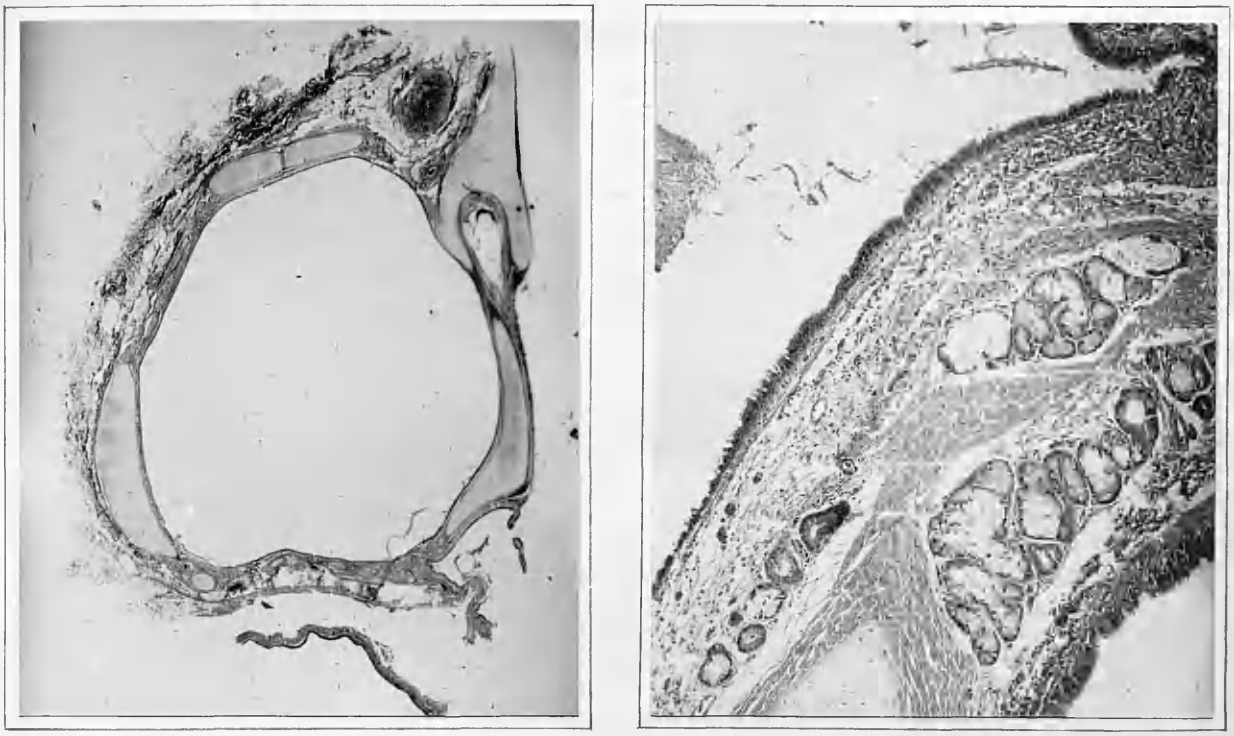


Fig. No. 64. The photograph on the left is a low power view to show one of the smaller cystic spaces with plaques of cartilage in its wall. The picture on the right is a high power view of the bottom right hand corner of the one on the left. It shows cartilage, mucous glands and ciliated columnar epithelium.

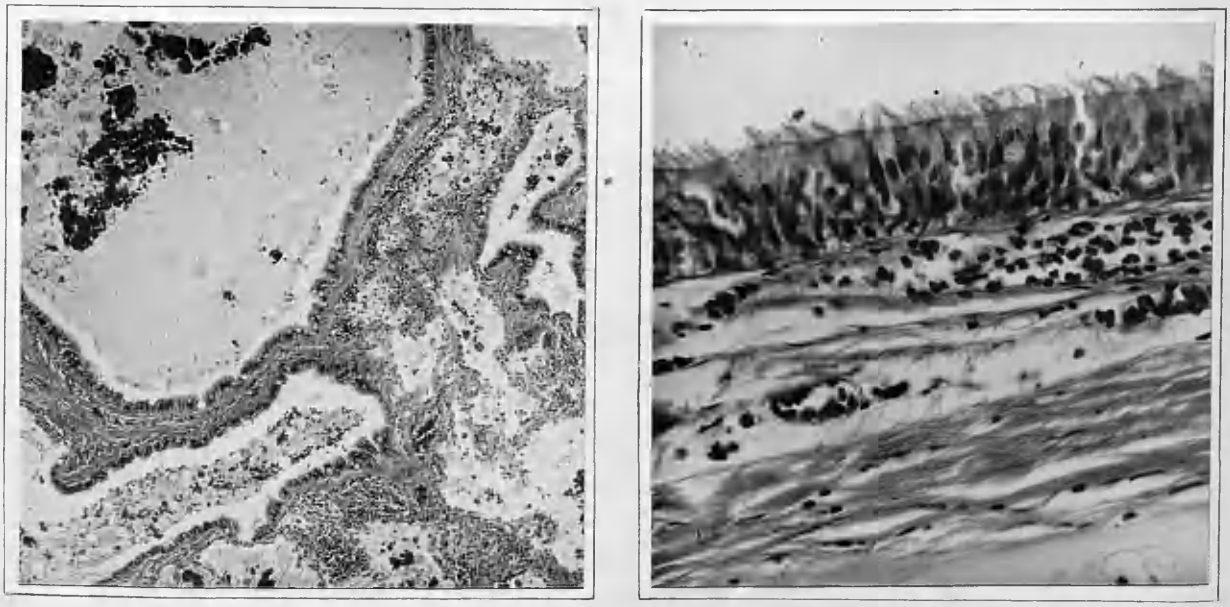


Fig. No. 65. Low and high power microphotographs of the wall of other cystic areas.

Case No. 21.

Mrs. McG. (29). Occupation - Housewife.

Admitted 13.2.47,

Dismissed 20.3.47.

Diagnosis Bronchogenic cyst.

History. Two years before admission and following the birth of a child she became breathless but she did not do anything about the breathlessness which eventually passed off. In July 1946, the breathlessness returned and seemed to be worse than previously. In October 1946, she developed pain in the left intercostal region. She was X-rayed in December 1946, and an intrathoracic cyst was found.

Examination. She was a pale, thin woman of bad posture. There was no cyanosis, dyspnoea or clubbing of the fingers.

Respiratory system. The left lower chest showed diminished respiratory movement and over this area the percussion note was dull and respiratory murmur was diminished. No adventitiae were heard.

25.2.47. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton,
Pentothal,
Cyclopropane.

A left postero-lateral incision was used to open the chest. The tumour, about 10 cms. in diameter, was found in front of and to the left of the heart, extending medially to the sternum to which it was partly adherent. The tumour was obviously cystic and faintly blue in places. It seemed to have a solid area in its postero-lateral aspect. (This was later found to be due to several small tense cysts).

The tumour was stripped out easily and was found to be extra-pleural in site. A narrow pedicle appeared to be attached to the pleura covering the region of the aortic arch. The wound was closed after the insertion of a "leak" tube. She was X-rayed after leaving the theatre and the left lung was found to be nearly fully expanded.

6.3.47. She was getting on very well and had been up.

20.3.47. She still had some fluid in her chest. She went home with the wound healed and the breathlessness gone.

Pathological Report, Mr. K. Fraser. "The tumour consisted almost entirely of one big cyst which

contained 125 ccs. of fluid. This fluid contained many small, what appeared to be fat, globules, but no cholesterol crystals were found. The solid area felt in the tumour was due to multiple small dense cysts; three segments were taken for histology."

Histological Report confirmed by Dr. Lendrum. "This cyst is lined by columnar cells. In some areas the cyst shows several layers of cells but this is due to the edge of the cyst having been cut tangentially.

Dr. Lendrum could offer no definite site of origin but agreed that it might be a pulmonary cyst of developmental origin".

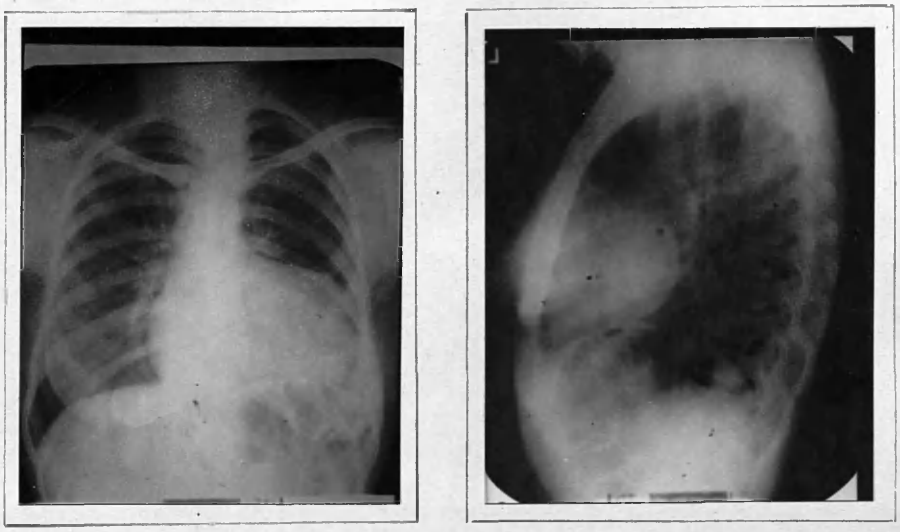


Fig. No. 66. Bronchogenic cyst lying in front and to the left of the heart.

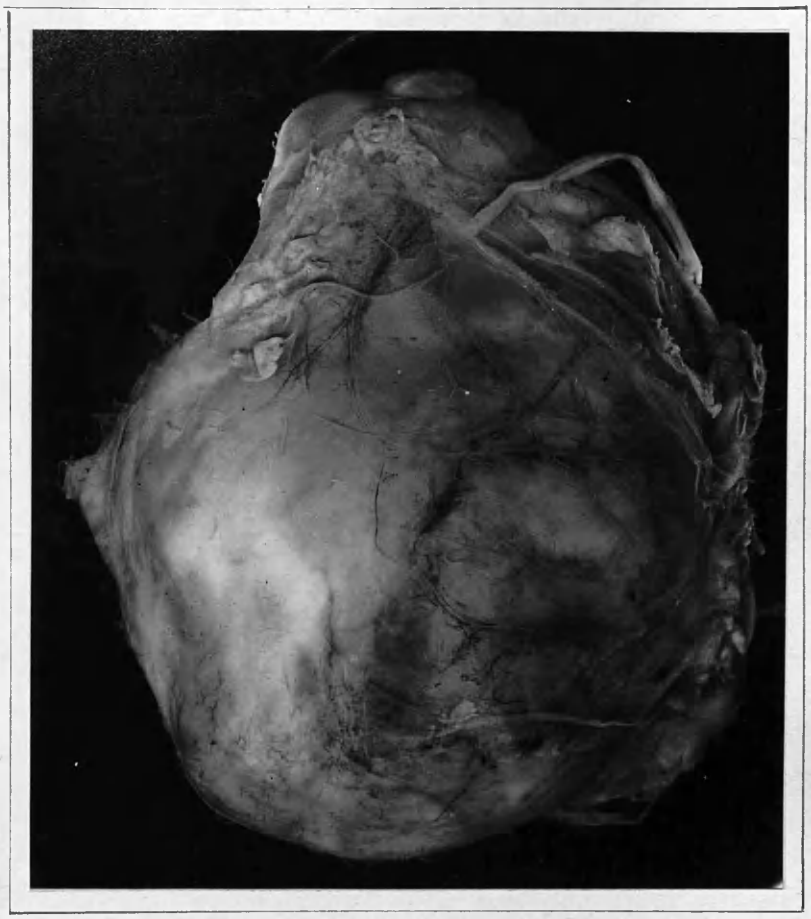


Fig. No.67. External appearance of the preserved specimen.

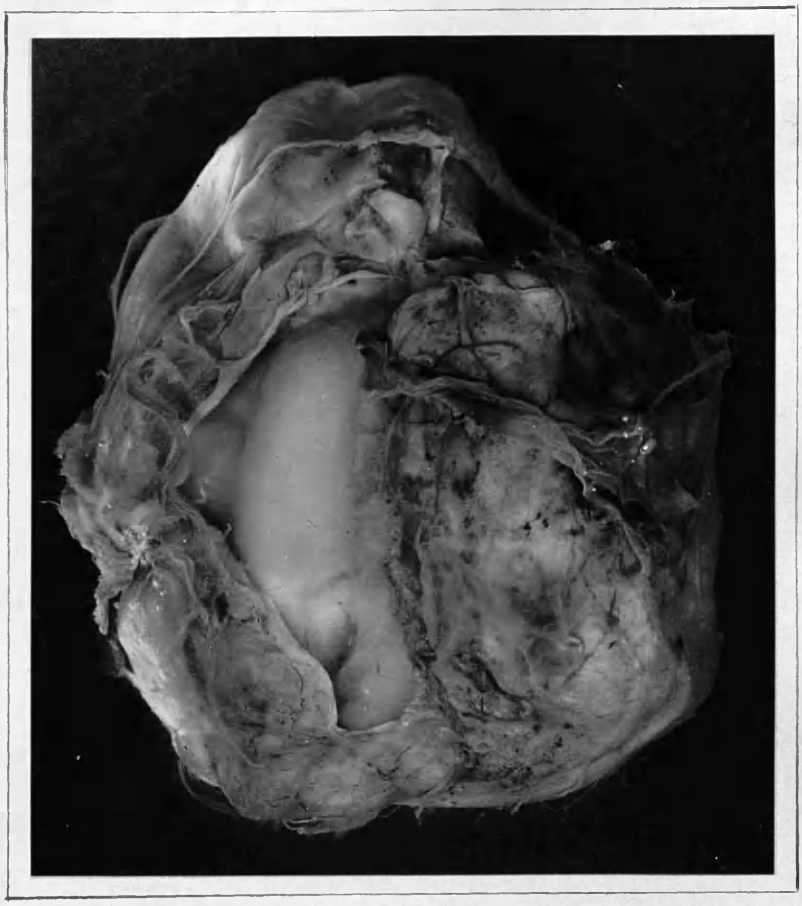


Fig. No. 68. The preserved specimen (filled with cotton wool).

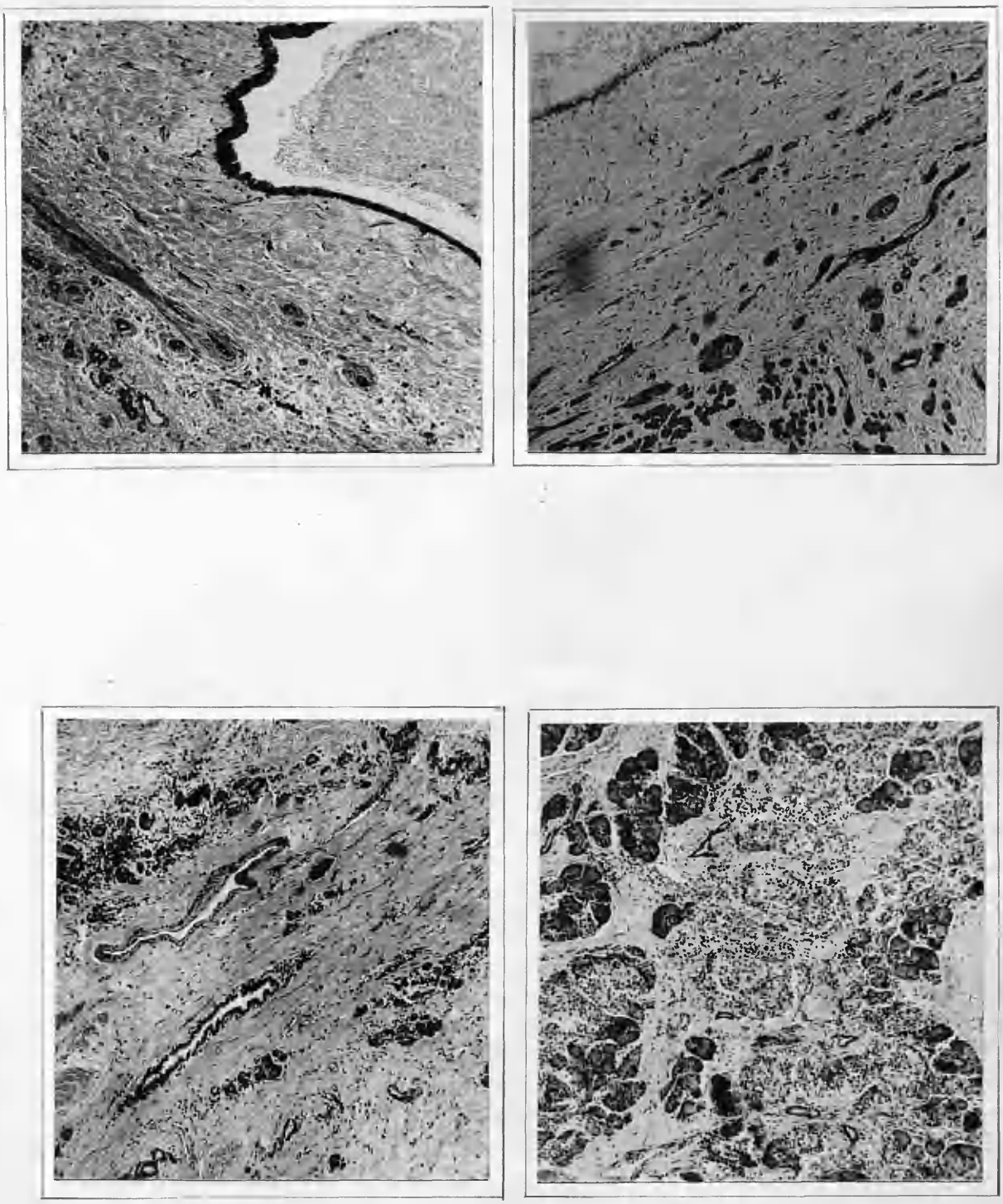


Fig. No.69. Low power representative areas. The cystic spaces are lined by columnar epithelium. Some muscle fibres are present.

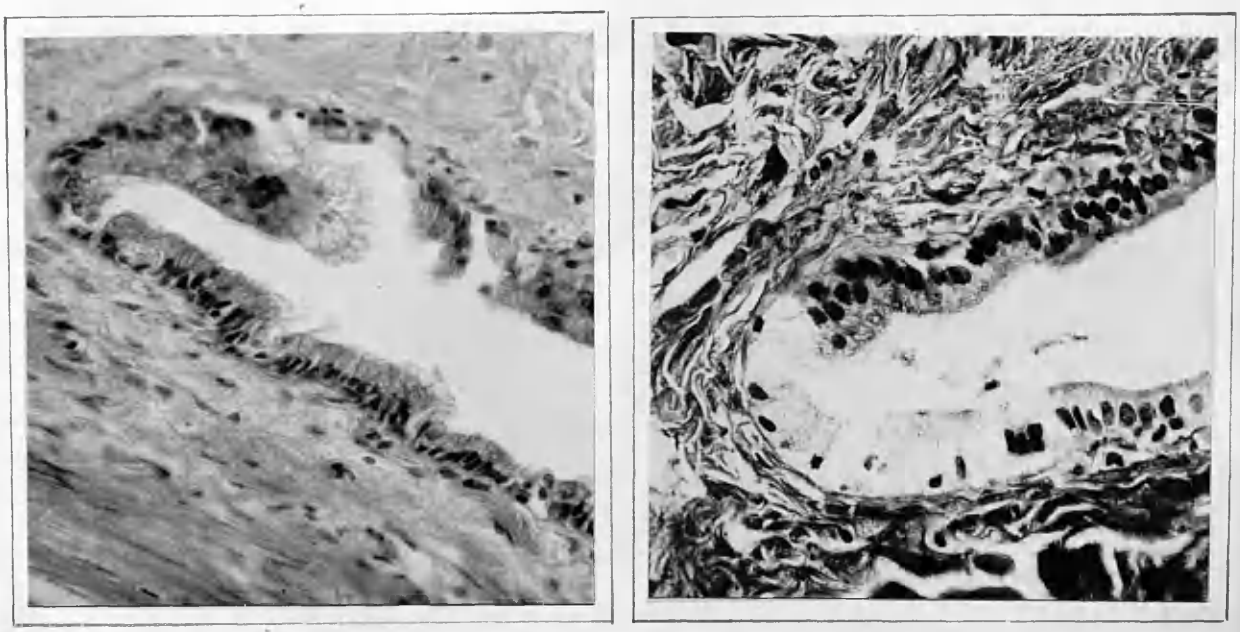


Fig. No. 70. High power view showing a space lined by columnar epithelium - probably ciliated.

Case No.22.

J.McF. (4).

Admitted 13.9.48,

Dismissed 13.11.48.

Diagnosis Bronchogenic cyst.

History. A good history was difficult to obtain in view of the child's age and due to the fact that only a brother aged 15 came with him and was unable to give a good account of his illness, but the child apparently had always been chesty and had had breathlessness on exertion for some time. He had had cough and spit.

Examination. He was found to be a pale thin child with a "pinched" look. There was slight cyanosis of the lips but no dyspnoea at rest in bed. There was no clubbing of the fingers and no oedema.

Respiratory system. There was a pigeon deformity of the chest. Chest movement was good and symmetrical. The percussion note was impaired over the lower half of the left chest anteriorly and in the left axilla posteriorly and there was some dullness medially on the right chest posteriorly. Respiratory murmur was diminished over the dull areas mentioned above.

Cardio-vascular system)
Central nervous system) No abnormality.
Genito-urinary system)

15.9.48. X-ray Report, Dr. McKail. "Ovoid mass of homogeneous density occupies the greater part of the right hemithorax. It measures approximately 10.5 x 9 cms. and its margins are well defined. It lies mainly posteriorly and has caused some separation of the ribs. The right main bronchus is displaced forwards and to the left, causing some obstruction. There appears to be some enlargement of the intervertebral foramina with erosion of certain pedicles. Examination of the dorsal spine is advised to show this more fully. If these findings are confirmed the above is either a neurofibroma or a ganglioneuroma".

23.9.48. Barium Meal, Dr. McKail. "No abnormality in stomach, small intestine or proximal colon".

24.9.48. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton - 640 mgm. Pentothal rectally and general anaesthesia.

Chest was opened through a right postero-lateral incision. A large cyst was found in the posterior mediastinum which had the appearance of

originating from the oesophagus. The cyst was aspirated and 550 ccs. of brownish black fluid was obtained. The cyst was dissected free, two thirds of the cyst wall were cut away to allow of easier access to the remainder which was fairly firmly attached to the oesophagus just below the azygos vein level. There was an adhesion between the cyst and the diaphragm, this was divided. The remainder of the cyst was cut away. A drainage tube was inserted and the wound was closed.

25.9.48. X-ray Report, Dr. McKail. "The right lung is almost completely re-expanded after removal of the tumour. There is a trace of fluid in the pleural cavity".

The fluid persisted over some weeks and there was some atelectasis of the right lower lobe.

Histological Examination of the cyst, Royal College of Physicians, No.3888/5427.

"1. The cyst wall is formed of layered fibrous tissue and that is all.

2. There is small round cell infiltration and there is what seems to be organising haemorrhage on the inner surface. There is no epithelial structure

anywhere and no epithelial lining to the cyst in these sections.

3. Sections of cyst wall adherent to oesophagus - (i) There is cyst wall in the structure similar to specimen "A". (ii) In addition on outer surface there is inflammatory fibrosis with chronic inflammatory cell infiltration.

This can only be described as a fibrous cyst and no opinion can be given for its aetiology that could not be better supplied by the surgeon".

16.10.48. His lung had completely re-expanded and the movement was good. He was active and cheerful and had gained four pounds in weight.

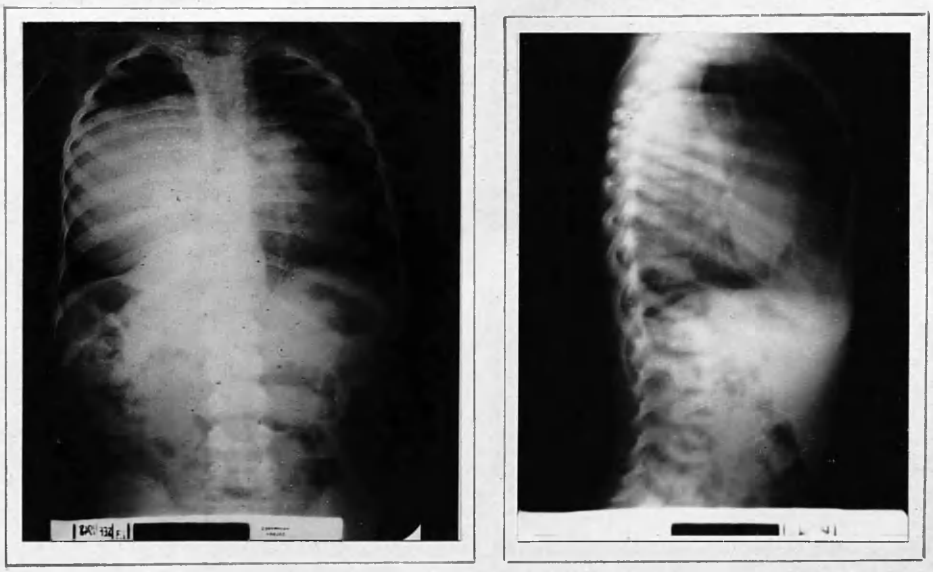
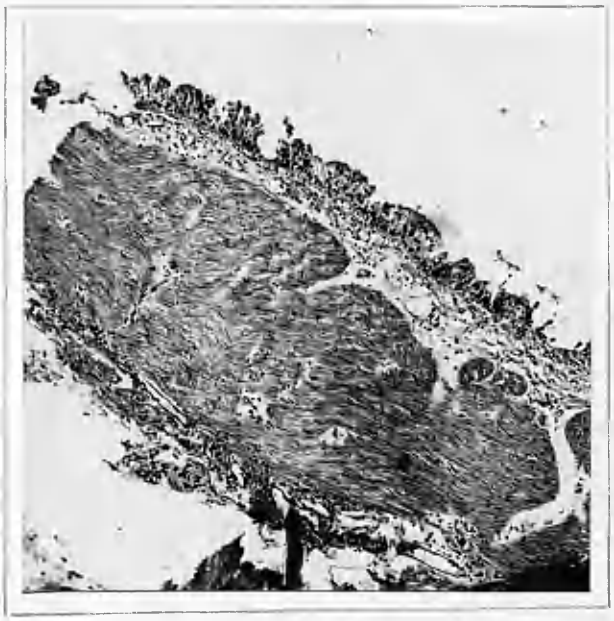
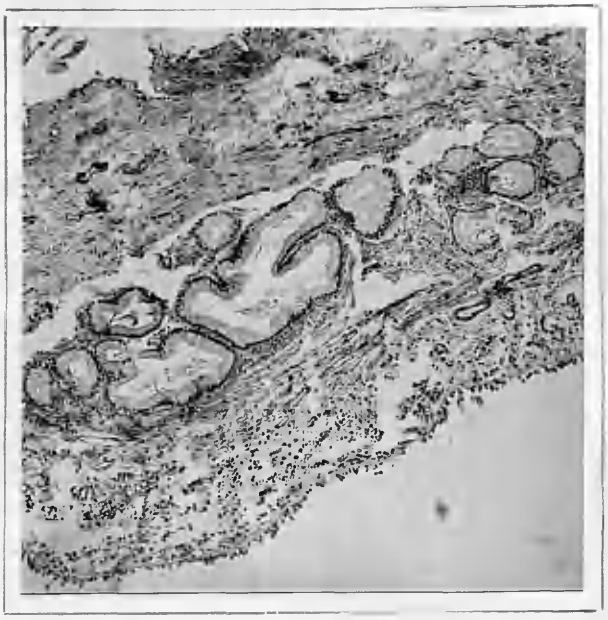


Fig. No. 71. X-ray films showing the bronchogenic cyst lying posteriorly. The displacement of the right stem bronchus forwards and to the left is well seen.





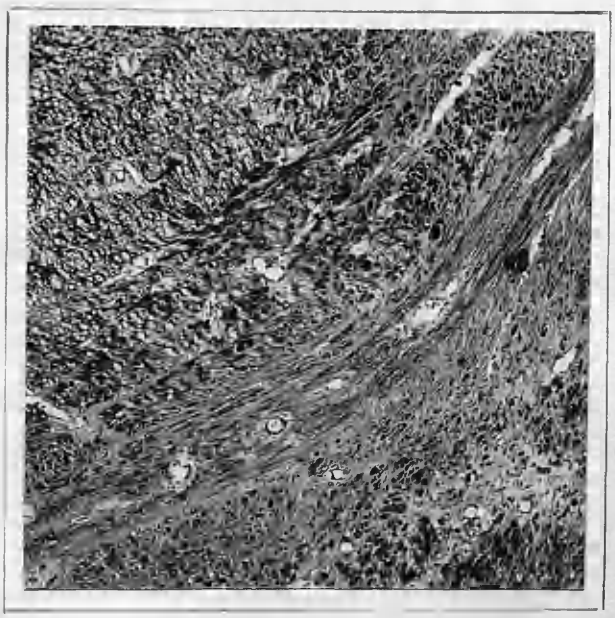


Fig. No. 72. Photomicrographs showing the fibrous tissue in the cyst wall also mucous glands. This tissue was taken from the areas preserved by me, one of the few areas which showed an epithelial lining is seen. The latter is very incomplete but appears to be columnar.

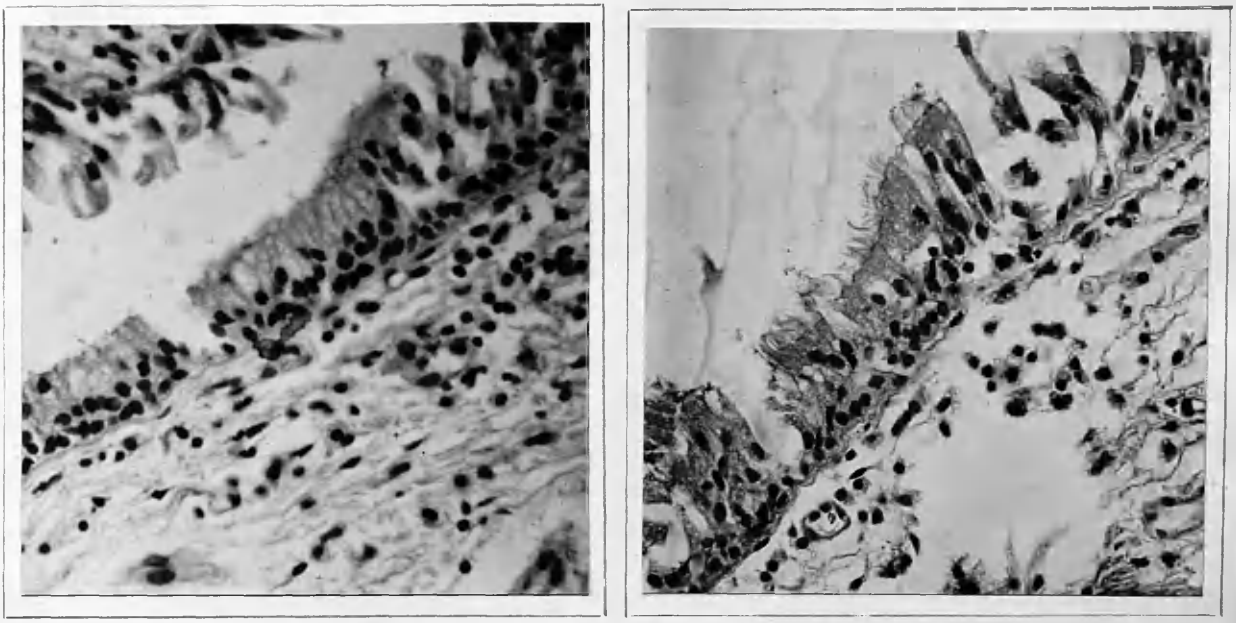


Fig. No.73. High power views confirm the columnar nature of the epithelium and the presence of cilia.

Case No. 23.

M.S. (40). Occupation - Typist.

Admitted 2.4.49, 17.10.49,

Dismissed 29.4.49, 23.11.49.

Diagnosis. Bronchogenic Cyst.

History. Five years prior to admission she had complained of occasional vague indigestion symptoms, which were mainly heartburn, flatulence and discomfort in the lower right chest anteriorly. One night prior to admission, she complained of pain in the lower right chest anteriorly which lasted some hours, and was finally relieved by alkaline tablets. During the last year her discomfort had been more troublesome and this had been especially true in the last three months. The discomfort came on after, though sometimes before, meals, was situated in the right lower chest, radiated round to the right chest posteriorly and occasionally crossed the mid-line of the epigastrium to the left side. She described the discomfort as a burning sensation, at first unaccompanied by nausea, but more recently it had been accompanied by nausea and later regurgitation but no actual vomiting (the regurgitation

consisted of partially digested food and never contained blood). There was no difficulty in swallowing and no sensation of her food sticking. She had had to resort to taking small meals, because a large meal made her feel full and she felt discomfort which was only relieved with regurgitation.
Her appetite was good but she was afraid to eat. She had tended to be constipated. During three months she lost a stone in weight. For many years she had had a cough which had been productive of sputum but was never blood stained. She had been slightly dyspnoeic on exertion but had no oedema.

Examination. She was of fair colour. Tongue was clean and moist. There was no clubbing of the fingers. She was a very nervous and apprehensive patient.

Respiratory System. Apart from numerous rales at both bases, no abnormality was detected in the chest.

Alimentary system
Cardio-vascular system } No abnormality.
Central nervous system

Haemoglobin 67%; Red blood cells 4,290,000.

4.4.49. X-ray Report, Dr. McKail. "There is a smooth ovoid soft tissue swelling 5 x 4 cms. behind

and below the right main bronchus. The carina is undistorted.

Barium swallow shows a smooth filling defect in the right wall of the oesophagus, slightly towards its posterior surface. The defect is lessened on distension and continuity with the soft tissue swelling is established.

The appearances are those of an intramural tumour of the oesophagus, probably a leiomyoma".

12.4.49. Operation - Mr. Dick, Mr. Fraser.
Dr. Pinkerton -
Pentothal,
Cyclopropane.

The left side of the chest was opened through the bed of the resected 7th rib. The left lung was completely free of adhesions. The mediastinal pleura was incised and the oesophagus was freed from the diaphragmatic hiatus up to the arch of the aorta. On retracting the upper part of mobilised oesophagus, a cystic swelling came into view. It measured 5 cm. in length by 4 cm. in breadth, appeared to be bluish in colour and was completely free of any oesophageal attachment. Further dissection showed that the cyst was attached by a narrow pedicle to the right main

bronchus. At this point, the cyst burst, and yellowish creamy material escaped. The cyst was then ligated at its pedicle and removed, the pedicle stump being left. Penicillin-sulphathiazole powder was dusted over the mediastinum, mediastinal pleura was freely opened and the chest was closed.

14.4.49. Pathological Report, Royal College of Physicians, No.7423/2095, Dr. Lees.

"1. This is a cyst.

2. It is lined internally by a single layer of ciliated columnar epithelium; outside that there is smooth muscle, separated by a thin zone of loose or fibrous tissue.

3. No evidence of malignancy.

4. Conformable with a bronchogenic cyst".

16.4.49. General condition was good and the drainage tube was removed, following which 300 ccs. of blood stained fluid was aspirated.

30.4.49. General condition was excellent. She complained of slight indigestion and a little regurgitation, but nothing to what it had been previously. She was discharged.

10.5.49. She reported back complaining of nausea

and squeamishness, but no regurgitation.

It is interesting to note that this patient was admitted to the Medical wards under Dr. Murray in October 1949, when she was in hospital for six weeks with a condition diagnosed as neurosis. During that time, she had a barium swallow which showed no abnormality.

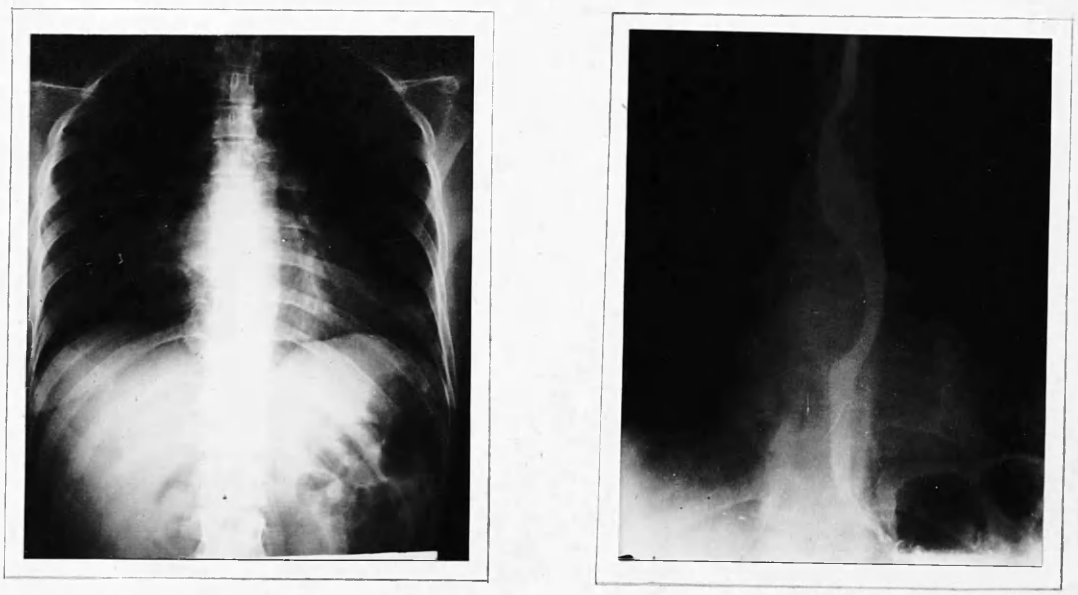
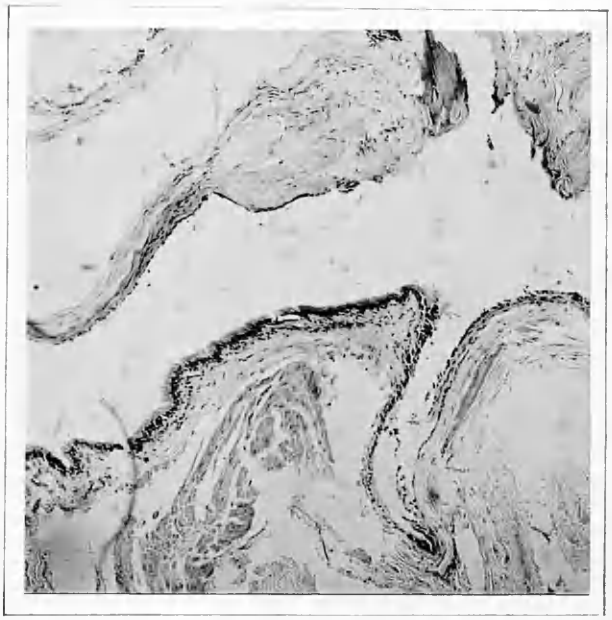


Fig. No. 74. Bronchogenic cyst causing indentation of the right wall of the oesophagus. The site and oesophageal indentation had suggested a diagnosis of intra-mural oesophageal tumour. The cyst was attached to the right main bronchus.



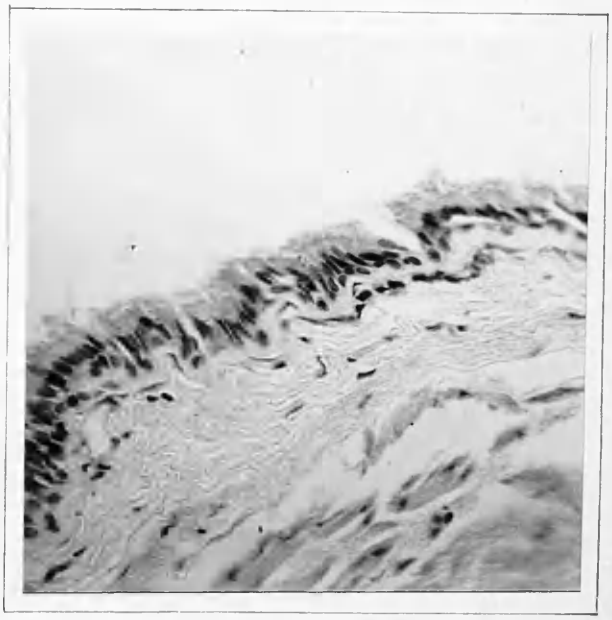


Fig. No.75. Sections showing the columnar epithelial lining, loose fibrous tissue and smooth muscle fibres.

Case No. 24.

I.C. ($4\frac{1}{2}$).

Admitted 6.10.45,

Dismissed 20.11.45.

Diagnosis Cyst.

History. Since the age of $1\frac{1}{2}$ years, and occurring at periodic intervals, the child had been seized by attacks of respiratory embarrassment accompanied by stertorous breathing suggesting fits, and general debility. On several occasions a considerable quantity of fluid had been aspirated from the left chest. Sometimes the effusion was clear and at other times it was haemorrhagic.

On examination, she was found to be a very listless and apathetic child of poor colour.

Respiratory system. Throughout the left side of the chest the percussion note was dull both anteriorly and posteriorly. Breath sounds were indistinct and vocal fremitus and vocal resonance were diminished.

Throughout the examination the child was subject to choreiform movements.

7.10.45. X-ray Report, Dr. McKail. "A large spherical swelling of fluid density occupied the

anterior mediastinum, the greater part in the left hemithorax and the lesser part in the right. The heart and trachea are displaced backwards and to the right to a considerable extent. The appearances are those of a dermoid cyst or teratoma".

Operation - Mr. Dick. Trocha and canula was inserted in the left side of the chest and 1500 c.c. of clear straw-coloured fluid were obtained.

5.11.45. X-ray Report, Dr. McKail. "Compared with films of 29.10.45, the left lobe had almost completely re-expanded. There is a small amount of residual fluid which is becoming loculated.

On account of the pericarditis and chorea the patient was transferred to the medical wards and no further surgical treatment was carried out".

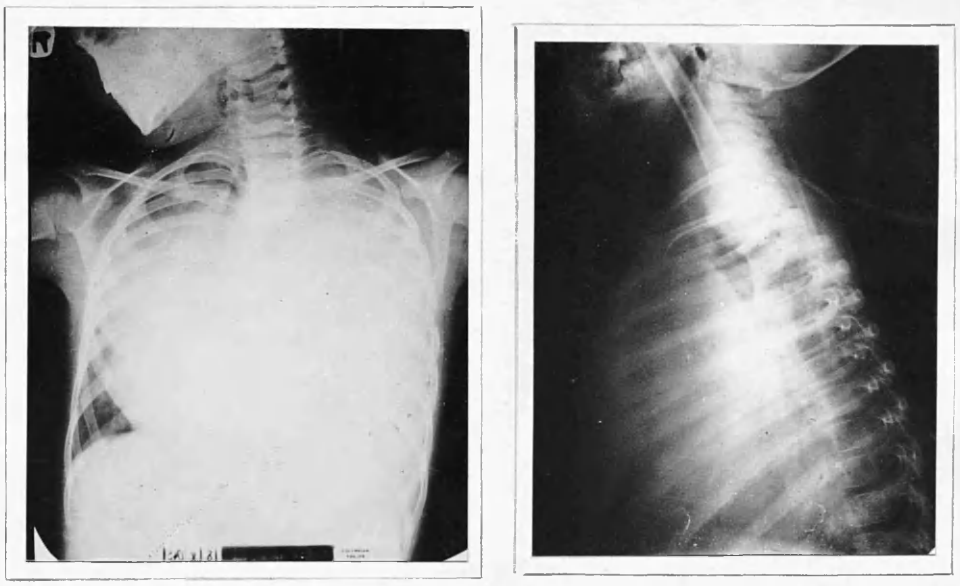


Fig. No.76. The posterio-anterior view shows the gross displacement of the heart and mediastinum to the right due to a massive shadow in the left chest which was thought to be a bronchogenic cyst. The lateral view reveals marked posterior displacement of the trachea.

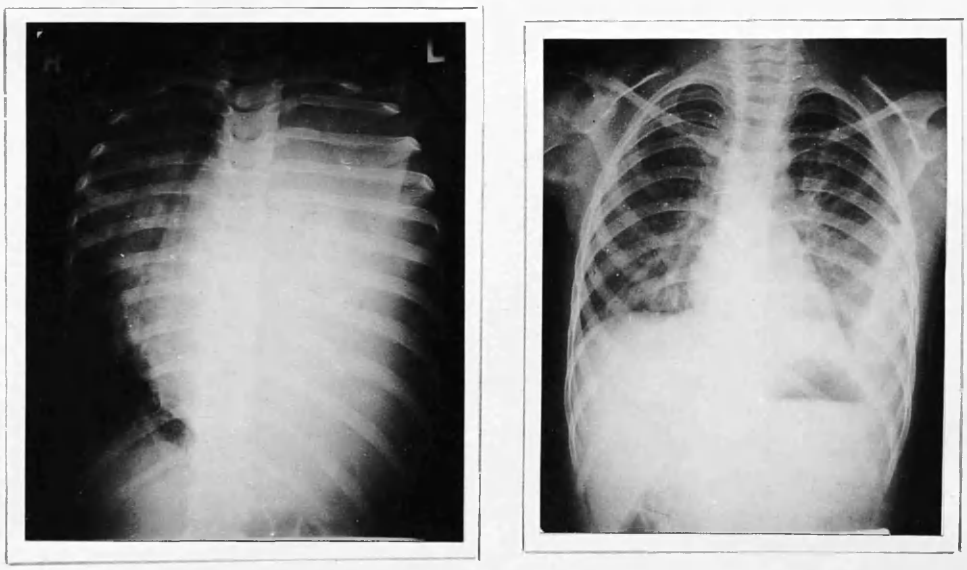


Fig. No.77. The "penetrated" x-ray film on the left confirms the gross displacement of trachea, stem bronchi and mediastinum to the right. The x-ray film on the right was taken after aspiration of 1500 c.c. of fluid - considerable re-expansion of the left lung has occurred.

Case No.25.

J.M. (12). Schoolboy.

Admitted 13.11.44,

Dismissed 29.12.44.

Diagnosis. Mediastinal dermoid cyst; chorea and pericarditis.

History. For 13 weeks he had been unwell, having developed severe substernal pain. At this time he developed a pericardial friction rub. He had pains in his joints for some weeks prior to admission.

Examination. Pale, thin boy. He had choreiform movements.

Respiratory system. The left side of the chest appeared to be enlarged and was found to be 4 cm. larger than the right.

Cardio-vascular system. A pericardial friction rub was heard at the right border of the heart.

14.11.44. X-ray report, Dr. McKail. "A large homogeneous mass occupying the anterior mediastinum and extending into the left lung field almost to the lateral chest wall. The margins of the tumour are slightly wavy. The trachea is displaced posteriorly almost to the spine, and also slightly toward the right.

The heart is displaced to the right and the superior vena cava is greatly dilated. The appearances are those of dermoid cyst".

1.12.44. General condition was not very good. He was very restless and weak.

28.12.44. He showed no improvement and it was felt his cardiac condition did not allow of operation. He was discharged home.

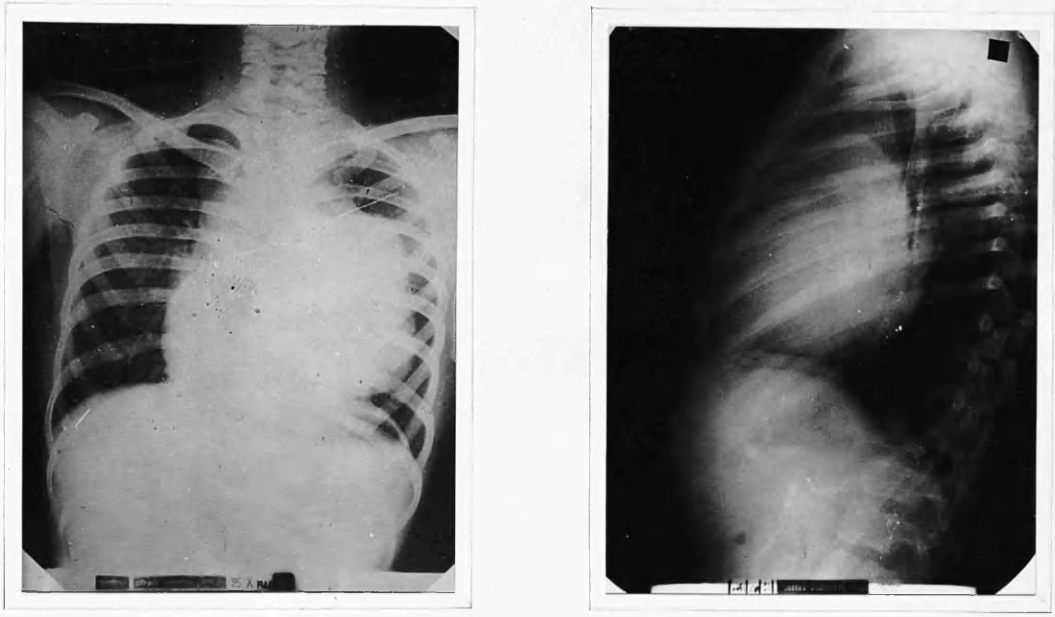


Fig. No. 78. Cystic shadow in the left chest thought to be a bronchogenic cyst. The heart is displaced to the right and the left stem bronchus is displaced posteriorly.

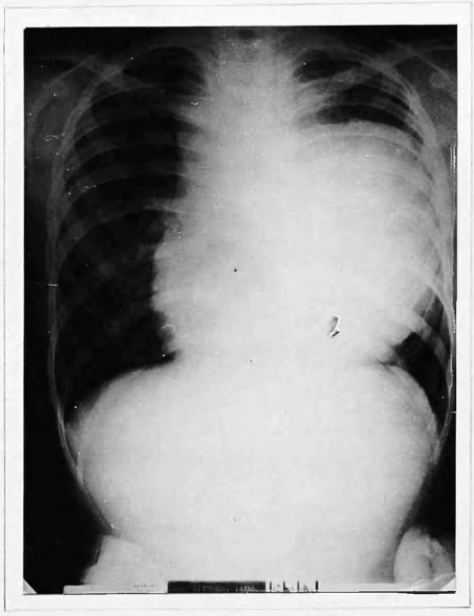


Fig. No. 79. X-ray film of the same case three weeks later: There is considerable increase in size.

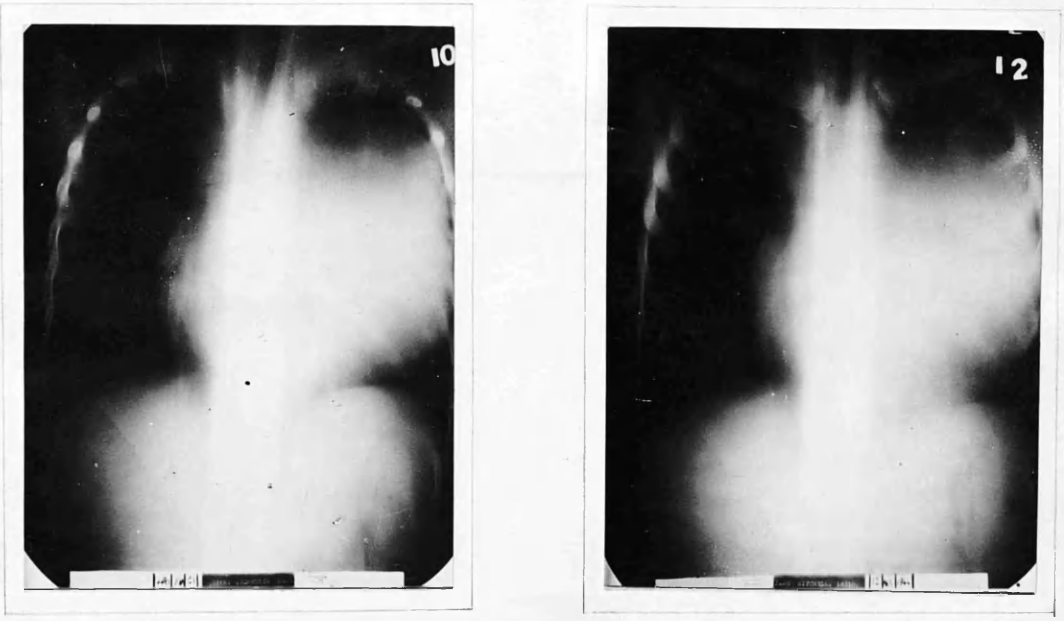


Fig. No. 80. Tomograph films taken at the same time as the original X-ray films shown on the previous page; they confirm the large size of the tumour and its anterior position. It is best seen 10 cm. from the back.

Case No.26.

M.M. (43).

Admitted 17.10.43,

Dismissed 17.12.43.

Diagnosis Infected cyst of left lung.

History. A year prior to admission he was seen by Mr. Dick, when he complained of cough and spit of one month's duration, and pain in the left upper thoracic region. He was X-rayed and was diagnosed as having a simple tumour.

He remained in fairly good health until 6 weeks prior to admission, when the cough which he had had for some time became much worse and his sputum became more copious; for 10 days prior to admission the sputum had become putrid in taste.

He was very breathless during the coughing attacks and on several occasions he had had blood streaks in his sputum. In the six weeks prior to admission he had lost about one stone in weight.

Previous health. He had had pleurisy and pneumonia three years previously; whooping cough as a child.

Examination. He showed marked loss of weight especially in the face. There was no oedema,

cyanosis or jaundice, but there was marked clubbing of the fingers. There was slight dyspnoea and a foetid odour from his breath.

Respiratory system. Movement was equal on the two sides. There was impaired percussion note and diminished respiratory murmur and vocal resonance over the right chest posteriorly, with numerous crepitations over both lungs and a tendency to broncho-vesicular breathing. Anteriorly, the left supraclavicular region was hollow and flat and the left chest showed bronchovesicular breathing, diminished movement and diminished respiratory murmur with numerous crepitations on both sides.

8.10.43. X-ray Report, Dr. Hurrell. "There is a large abscess cavity in the left lower lobe. Left upper lobe shows a possible hilar opacity and general loss of translucency, which could be due to bronchial neoplasm and atelectasis; the appearances could all be due to general pleural thickening from the abscess, and it is not possible to say at this stage if both conditions are present".

12.10.43. Operation - Mr. Dick. Local anaesthetic. The cavity was punctured by a trocha and

cannula whereupon 200 ccs. of pus were evacuated. The wound was closed.

13.10.43. X-ray Report, Dr. Hurrell. "The cavity was slightly fuller".

14.10.43. Report on pus:-

"The culture was sterile.

No cocci found on direct examination.

No tubercle bacilli".

15.10.43. The cavity was again punctured by a trocha and cannula and a catheter was inserted and attached to sealed drainage.

16.10.43. X-ray report showed the cavity was almost empty.

21.10.43. Drainage from the cavity averaged 3 ozs. daily.

17.12.43. He died suddenly after a cardiac collapse.

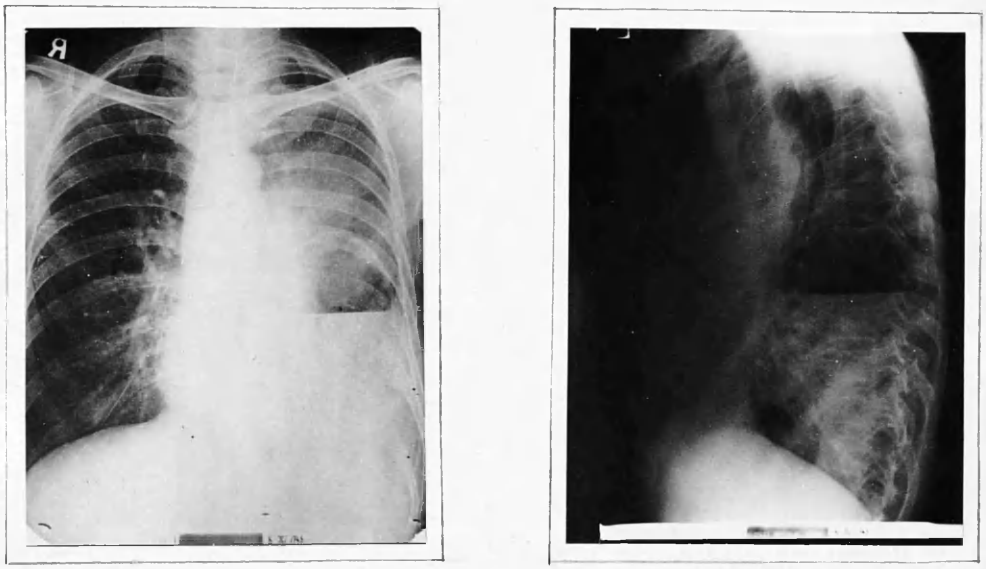


Fig. No. 81. X-ray films showing the presence of a thin-walled cystic space in the region of the apex of the left lower lobe. There is a fluid level within the cyst. There is some atelectasis of the upper lobe presumably the result of pressure on the upper lobe bronchus. This was thought to be a case of infected lung cyst.

Case No.27.

M.G. (19). Occupation - Shop Assistant.

Admitted 6.3.50.

Dismissed 26.4.50.

Diagnosis Congenital cystic disease of lung.

History. At the age of 2 years she had had an attack of congestion of her lungs, and during her school years she was off repeatedly for short spells with respiratory attacks. She had been breathless on exertion for as long as she could remember and she had had a cough with spit for many years, but the spit was never blood stained. Three years prior to admission she had an attack of pleurisy which she thought was on her right side. Apart from this, she had never had pain in her chest. She had an attack of bronchial catarrh about the New Year and investigation at that time suggested that she had extensive bronchiectasis of her right lung.

She had not been troubled with sore throats but had had some nasal obstruction. Her tonsils and adenoids were removed when she was aged 14. Previous health had been satisfactory.

Examination. She was a young girl of small physique and average height and nutrition. There was no clubbing of the fingers and the lymph glands were not palpable.

Respiratory system. There was extensive percussion impairment on the right side of the chest, as evidence of gross bronchiectasis affecting all three lobes, especially the lower lobe which was collapsed. There was gross mediastinal shift to the right.

Cardio-vascular system.)
Alimentary system.) No abnormality.
Genito-urinary system.)
Central nervous system.)

7.3.50. X-ray Report, Dr. McKail. "Cystic bronchiectasis involving what appears to be the whole of the right lung. There is considerable mediastinal displacement to the right".

13.3.50. X-ray Report, Dr. McKail. "Sinuses - There is some thickening of the mucous membrane in both antra".

20.3.50. X-ray Report, Dr. McKail. "Left Bronchogram - No abnormality is seen".

28.3.50. Operation - Mr. Fraser, Mr. McLuskie.

Dr. Pinkerton -
Pentothal,
Cyclopropane,
Tubarin.

The right side of the chest was opened by the usual postero-lateral incision. The 5th and 6th ribs were excised and the intervening intercostal muscle was preserved. The lung was firmly adherent to surrounding structures but was mobilised completely by working partly intra and partly extra-pleurally. The lung tissue was completely replaced by a cluster of grape-like cysts. The bronchus was first isolated, clamped and divided. The dissection was then continued within the pericardial covering of the hilar vessels. The pulmonary artery was displayed, doubly ligated and divided and the superior and inferior pulmonary veins were similarly dealt with. The bronchus was cut close to the carina and sealed off with atraumatic silk sutures, a series of mattress sutures proximally and single sutures distally. The intercostal muscle was then stitched to the bronchial stump. Penicillin-sulphathiazole powder was applied to the hilar stump, the phrenic nerve was crushed and a drainage tube was inserted, through a separate opening. The chest was closed with 50,000 units of penicillin.

30.3.50. The drainage was satisfactory.
Pathological Report, Mr. K. Fraser. "After preservation the lung is very much smaller than normal. Its external aspect shows an umbilicated surface not unlike a cluster of grapes due to the presence of cysts throughout the lung substance. On section the impression gained from the external appearance is confirmed in that the lung is a shrunken collection of cysts not unlike the appearance of hydronephrotic kidney. The cysts are of varying size, shape and appearance. In some the wall is several millimetres in thickness, in others it is so thin as to be transparent. There is no normal lung tissue left."
24.4.50. The right chest was aspirated and gelatinous fluid was obtained. The patient was ready for discharge and she was dismissed on 26.4.50.
26.5.50. She reported as an Outpatient. Her condition was excellent. She had no sputum and had put on three pounds in weight.
30.8.50. She reported and her condition was excellent.

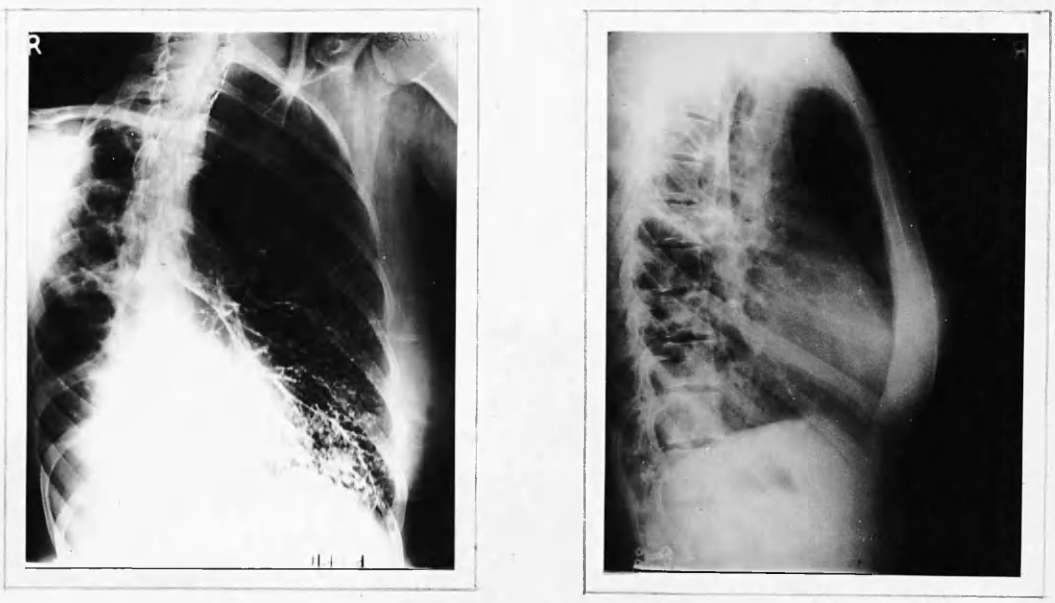


Fig. No. 82. Cystic bronchiectasis of right lung. There was marked displacement of the mediastinum to the right; this is masked by the oblique angle at which the film on the left has been taken. The bronchogram confirms the normality of the left bronchial tree.

Fig. No. 83. The preserved specimen of lung. The cystic spaces are well seen, many are thin-walled. There is practically no normal lung tissue. There is some resemblance to a hydronephrotic kidney.

Case No. 28.

G.H. (10). Schoolboy.

Admitted 9.1.52,

Dismissed 22.3.52.

Diagnosis Congenital cystic bronchiectasis.

History. He had apparently been troubled by his chest for several years and especially since his pneumonia at the age of three months. He was prone to colds and bronchitis especially in the winter and only at that time did he complain of cough and sputum which had never been blood stained. His usual complaint was that of wheeziness and occasionally breathlessness on exertion.

The child was due to have his teeth extracted and his doctor advised X-raying his chest prior to giving him an anaesthetic. This was done and he was then admitted to Hairmyres. He was an extremely small boy, who was intelligent but underweight. Posture was extremely poor and there were audible wheezes in his chest.

Respiratory System. Gross signs of bronchiectasis associated with broncho-spasm in the right chest with moist sounds heard at the left base which were not thought to be transmitted from the right side.

X-ray Report, Dr. Cuthbert. "There is evidence of atelectasis of partial type involving the whole of the right lower lobe. Numerous cavities are visible within the lobe and also in relation to the middle lobe and antero-lateral segment of the right upper lobe. The appearances are in favour of fibrocystic bronchiectasis. There is considerable displacement of the heart and mediastinum to the right with compensatory emphysema of the left lung and herniation of this lung across the posterior mediastinum towards the right side."

7.3.52. Operation - Mr. Fraser. Dr. Stirling - Pentothal, Tubarin, Gas & Oxygen.

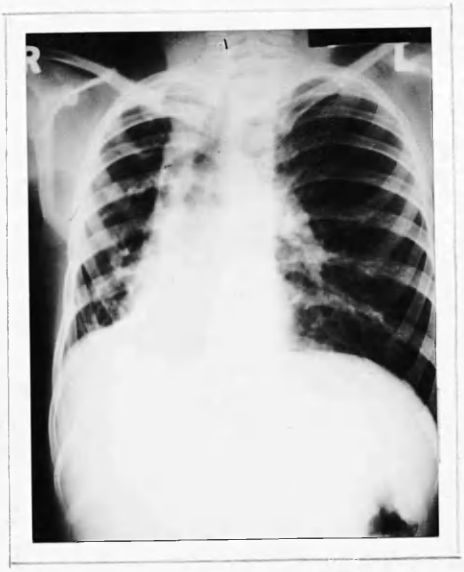
Face-down, head-down position. The 6th rib was resected. The pleural space was free but the whole of the lung when inflated by the anaesthetist consisted of a cystic grape-like mass. The bronchus was clamped and divided. The pulmonary artery, inferior and then the superior veins were dissected out, ligated, transfixed and divided and the lung removed. The bronchial stump was dusted with penicillin-sulphathiazole powder and almost completely covered with mediastinal pleura. The phrenic nerve was crushed.

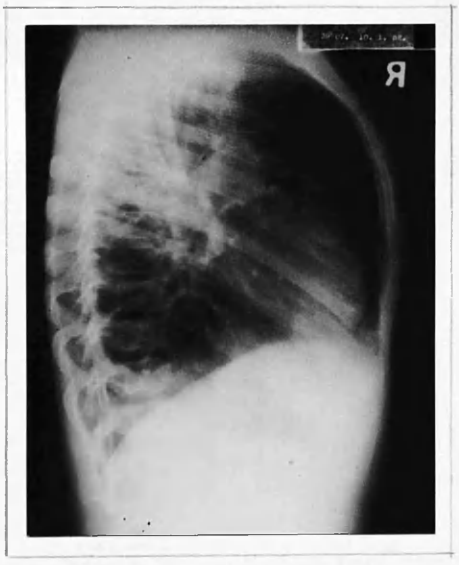
Pathology Report, Edinburgh University, Dr. McGregor. "There is no evidence of tuberculosis. The cysts or dilated bronchials are lined by ciliated columnar epithelium and contain little inflammatory exudate. There is a varying amount of surrounding fibrosis and inflammatory reaction. In some there is very little while others show very marked fibrotic thickening, infiltration of chronic inflammatory cells, that is, plasma cells and lymphocytes, and numerous lymphoid follicles with germ centres. In general, intervening lung tissue is collapsed and fibrosed. The alveoli are diminished, their walls show fibrous thickening and the lining epithelium is cuboidal and columnar. There is so-called foetalisation. The vessels show fibrous thickening of the walls.

Conclusion - Certainly, the appearances are compatible with congenital cystic bronchiectasis, although the long standing inflammatory condition has produced a picture indistinguishable from the acquired condition".

19.3.52. He has been up and about for some days and is very well.

22.3.52. Discharged home.





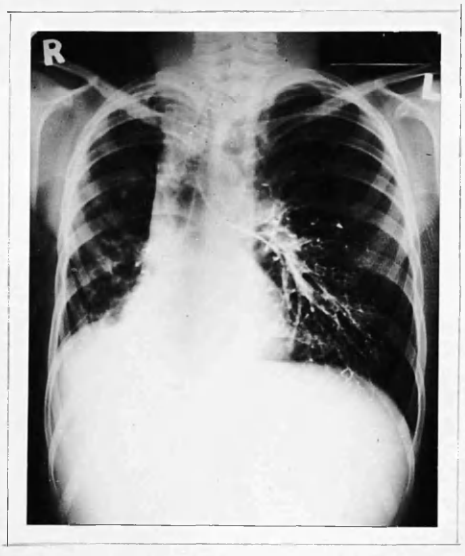


Fig. No. 84. Cystic bronchiectasis of right lung with moderate atelectasis. There is compensatory emphysema of the left lung with displacement of the heart and mediastinum to the right. This was thought to be a case of congenital type.

Case No. 29.

S.M. (20). Occupation - Shop Assistant.

Admitted 1.2.50,

Dismissed 21.4.50.

Diagnosis Cystic bronchiectasis of upper lobe of lung.

History. In November 1949, she had coughed up some blood stained material but there had been no recurrence of this haemoptysis. She had been off work and resting since November 1949, but had not been confined to bed. On admission, she felt breathless on exertion and had a cough.

At the age of 2 she had measles and whooping cough and she had also had a septic condition of her leg. These conditions kept her 7½ months in the Wester Moffat Hospital. The greater part of her schooldays had been spent at a Special School. She had had a cough and a wheezy chest since early childhood. She had always been subject to chest colds but had had no long period of illness in recent years.

Examination. She was a girl of poor physique and nutrition. There was dental caries. The fingers were not clubbed and there were no enlarged glands.

Respiratory system. The percussion note was not impaired. There were coarse rales felt and heard all over the upper lobe and lingula. A few rales were heard over the right apex.

Cardio-vascular system, revealed a gross systolic murmur at the apex.

Alimentary system.) No abnormality.
Central nervous system.)

2.2.50. X-ray Report, Dr. McKail. "Cystic bronchiectasis involving the greater part of the upper lobe of the left lung".

21.2.50. X-ray Report, Dr. McKail, left Bronchogram. "Cystic bronchiectasis involving the apical and pectoral segments of the upper lobe".

3.3.50. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Cyclopropane,
Gas & Oxygen.

The left chest was opened through the bed of the resected 6th rib. The lung was adherent all round the chest wall but was easily stripped free and the fissure was opened up. Dissection of the hilar structures was difficult on account of enlarged hilar glands but the two tributaries of

the superior pulmonary vein were isolated, ligated and divided between transfixing sutures. In view of the difficulty of dissection and the amount of blood that was being lost, it was decided to complete the lobectomy by the transfixion-ligation method. A series of silk sutures were inserted round the hilum and the lobe was cut away. The stump left was quite small. Penicillin-sulphathiazole powder was dusted over the stump, the lower lobe was freed from the chest wall, a de pezzer catheter was inserted for drainage in the 2nd interspace anteriorly, and an additional drainage tube was inserted posteriorly low down.

6.3.50. Pathology Report, Mr. K. Fraser. "The upper lobe of the lung is almost completely replaced by bronchiectatic changes".

6.3.50. Royal College of Physicians Laboratory, Dr. Dawson. "No evidence of tuberculous infection.

Bronchiectasis with marked complex sacculation of bronchi and bronchioles which form duct-like structures in the submucous granulomatous tissue - the parenchyma (alveolar) varies greatly. Extensive fibrosis has destroyed alveoli in many

areas, in others there is extensive bronchiolisation of alveoli, producing lining cells of cubical type, with loss of their normal structure round terminal bronchials - there is extensive chronic and acute inflammatory cell reaction and much fibrosis, with compensatory emphysema - the larger vessels show considerable sclerotic narrowing of their lumen".

4.3.50. General condition satisfactory. Remaining lung partially expanded.

9.3.50. Chest aspirated; Blood stained fluid withdrawn to the quantity of 300 ccs. General condition satisfactory.

16.3.50. A needle was inserted posteriorly and 60 ccs. of blood stained fluid withdrawn. 50,000 units of penicillin were injected into posterior pockets of fluid.

21.4.50. Allowed home well.

18.5.50. Reported as an Outpatient. General condition excellent. Sputum free. Posture good.

2.3.51. Reported. Condition excellent. X-ray satisfactory.

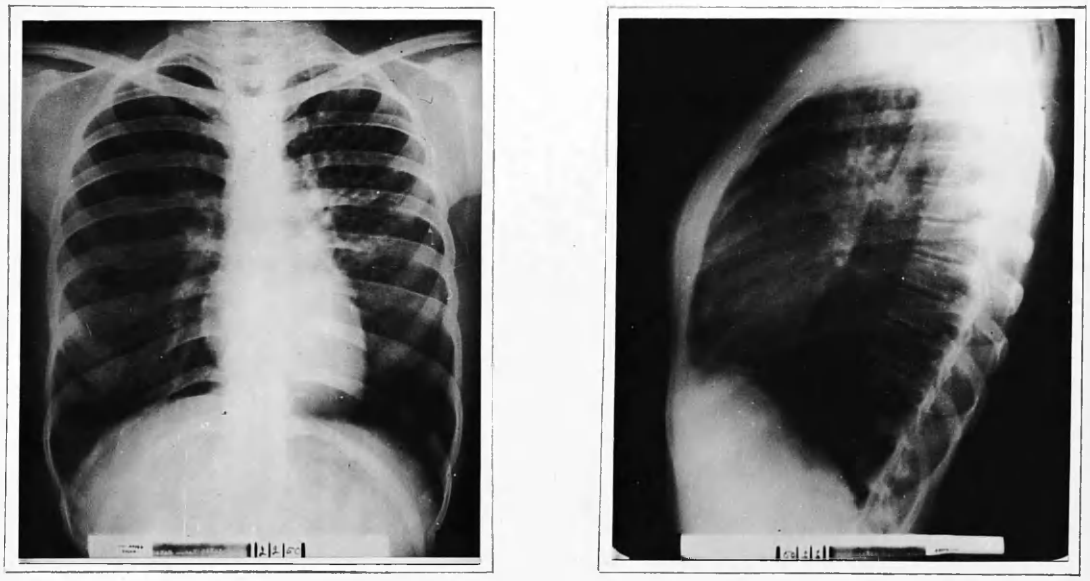


Fig. No. 85. Cystic bronchiectasis of left upper lobe. Some similarity to "links of a chain" can be seen in both X-ray films.

Fig. No. 86. The preserved specimen. The upper lobe is practically replaced by bronchiectasis.

Case No.30.

E. MacK. (43).

Admitted 12.12.46, 8.1.47,

Dismissed 20.12.46. 9.6.47.

Diagnosis Bronchiolectasis of both lungs.

History. Eighteen months prior to admission to hospital he had been climbing a steep hill with some friends when he found he was unduly breathless. Since then, the breathlessness had become increasingly more marked and on admission he was breathless unless he was in bed or sitting still in a chair. He had gradually developed a continuous cough during this time; it was short, and was accompanied by some frothy mucoid sputum.

In September 1946, after a paroxysm of coughing the sputum became blood stained. This persisted for one night but it had never recurred. A few nights later, after a further bout of coughing, he found himself aphonic. After a few days his voice returned but was still quite husky.

Appetite was good. There was no loss of weight and his bowel habit was regular. There was no history of exposure to fumes or dust.

He had been to South America but had had no illnesses while there.

Family history. One brother died of pulmonary tuberculosis in South Africa. Prior to his brother going to South Africa and while he was ill with tuberculosis, he had stayed with him for some time.

Examination. He was a well nourished man, slightly cyanosed and breathless. There was clubbing of the fingers. There were no enlarged glands.

Respiratory system. The chest moved equally on both sides. The percussion note on the right side was slightly diminished. On auscultation the breath sounds were vesicular with prolongation on expiration. At the right base the breath sounds were broncho-vesicular. Fine crepitations were heard in both sides of the chest.

Alimentary system.
Central nervous system
Cardio-vascular system
No abnormality.

13.12.46. X-ray Report, Dr. McKail. "There are multiple small nodules in both lungs".

The patient was allowed home without any change occurring in his condition.

8.1.47. Re-admitted. He had been well until four days previously, when he developed a chill and three days previously a slight haemoptysis.
Examination revealed him to be much more cyanosed than previously, and he was very breathless.
Respiratory system revealed slight dullness at the right base, with tubularity and coarse crepitations.
Vocal resonance was increased. He was put on to oxygen.

15.1.47. He was seen by Dr. Gow Brown who stated that he had grown a growth of candida albicans from the sputum. He was put on to potassium iodide gr. 10 t.i.d. Later, this dose was increased to 35 grs. 4 hourly.

25.1.47. B.S.R. was 4 mm.

6.2.47. Dr. Howie, Laryngoscopy. "Examination of larynx showed a recurrent laryngeal nerve palsy on the left side. There is no evidence of obstruction of breathing at this level. Lung puncture was carried out on the right chest and was followed by a spontaneous pneumothorax, accompanied by much distress to the patient, from which he recovered with increased oxygen."

3.4.47. X-ray Report, Dr. McKail. "There has been

some further consolidation in the left lower lung fields. The appearances are rather suggestive of metastatic disease".

2.5.47. He had been using a large oxygen cylinder now for over two months. He became rapidly cyanosed when the oxygen was stopped and equally rapidly recovered colour on resumption of oxygen therapy. Serum proteins were 8.5 grms per 100 ccs.

28.5.47. X-ray Report, Dr. McKail. "A rather poorly defined mass is seen occupying the anterior part of the superior mediastinum and causing displacement of the trachea backwards and to the right. It projects on either side of the mid-line. The hilar shadows are also enlarged. The lung fields show diffuse opacities. Part of this appears to be due to vascular congestion, but the presence of larger nodules indicates that there is also infiltration with pathological tissue.

Assessment of progress is difficult on account of the different techniques used, but it appears that no great change has taken place since 12.12.46.

These appearances are most probably due to mediastinal tuberculosis, with diffuse involvement of the lungs".

5.6.47. General condition had deteriorated and further increase in oxygen supply was called for. The pulse at times was irregular in rate and rhythm. The liver was now found to be enlarged.

5.6.47. X-ray Report, Dr. McKail. "Compared with ward film 28.5.47, the appearances are essentially unchanged".

9.6.47. He had become progressively more cyanosed and dyspnoeic and died.

Post-mortem Report, Dr. Halcrow.

Respiratory system. The trachea was normal, apart from slight congestion.

Right pleura: a few adhesions present, otherwise normal.

Right lung: firm in consistency. On section, it was found to be a mass of small cysts separated by fibrous tissue. Only in a few small areas were parts of almost normal lung tissue found. Generally, there was practically no functioning lung structure. In places, the lung was almost honeycombed with small cysts.

Left Lung: presented appearances markedly identical with those of the right lung. Numerous cysts were

present with intervening fibrous tissue and little or no normal lung tissue.

Numerous emphysematous bullae were present on the surface of both lungs.

Cardio-vascular system: the only abnormality of note was that both ventricles were hypertrophied and slightly dilated.

Lymphatic glands: the mediastinal glands were slightly enlarged and haemorrhagic.

Alimentary system: the liver showed slight chronic venous congestion.

Spleen: normal in appearance.

Permission to examine other organs was not obtained.

Weight of organs: Heart 16 ozs.
R. Lung 30 ozs.
L. Lung 30 ozs.
Spleen 7 ozs.

Abstract of Histological Report, Royal College of Physicians Report.

LUNG: (1) No tissue which could be described as normal lung parenchyma.

(2) Cystic tubular dilatations of varying size. Some of these still have a lining of relatively well preserved columnar epithelium. In the rest there is a partial, or complete, loss of the epithelial lining.

(3) Pronounced diffuse fibrosis, the fibrous tissue showing gross density and a slight alveolarity surrounds the cystic space.

(4) A greater or less degree of collapse.

(5) Vascular congestion and intra-alveolar serous exudate.

(6) Infiltration with lymphocytes, focal and diffuse, but no pus formation; pigment containing phagocytes, so-called hard but alveolar cells are fairly numerous.

It is easy to prove how grossly impaired respiratory gaseous exchange would be.

(7) No evidence of tubercle, malignancy, asbestosis.

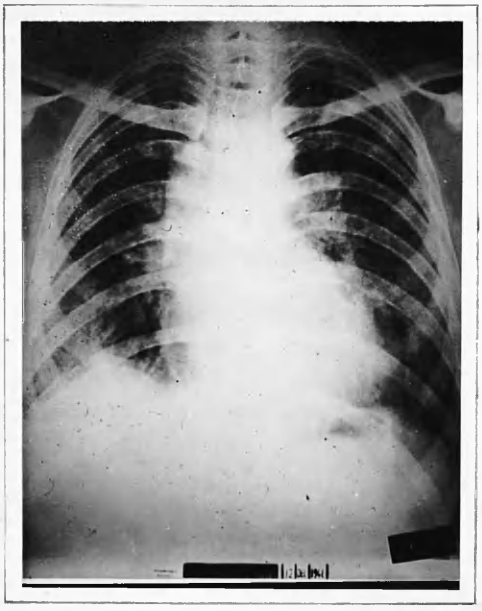
Examination of lymph node: no evidence of tubercle. Considerable haemorrhagic congestion and a marked degree of sinus reticulosis. A reacting lymph node.

SPLEEN: General congestion of the pulp. Slight increase in size of malphigian bodies and some thickening of the fibrous trabeculae.

LIVER: Mild degree of chronic venous congestion. Generalised cloudy swelling, whose diffuseness indicates amyloid change. No inflammatory cell infiltration.

SUMMARY: This appears to be a case of chronic bronchiolitis cystica. Autopsy revealed practically no functioning lung tissue, and these findings explain very well the terminal basis of intense cyanosis and dyspnoea.

The lungs and the histology of this case were shown to Professor Cappell and Dr. Lendrum, who were of the opinion that this was a case of bronchiolectasis; that the lungs had in places almost a fleshy appearance and every indication suggesting that the condition had been present for at least a considerable number of years.



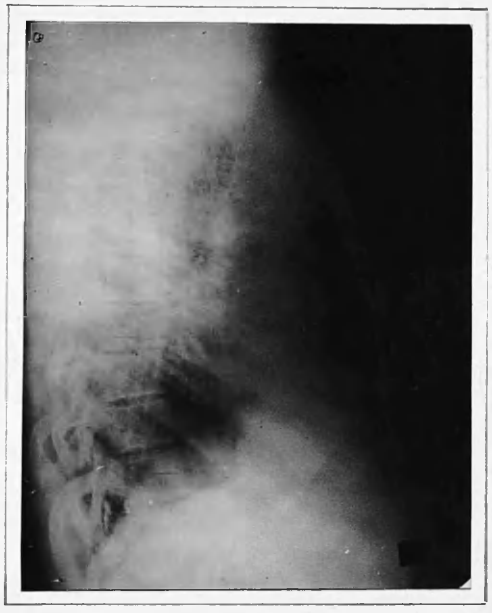
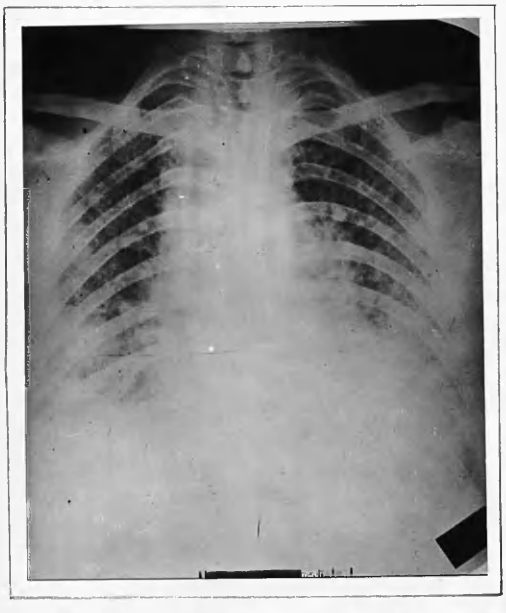


Fig. No. 87. X-ray films taken on 12.12.46 show multiple small opacities in both lungs.



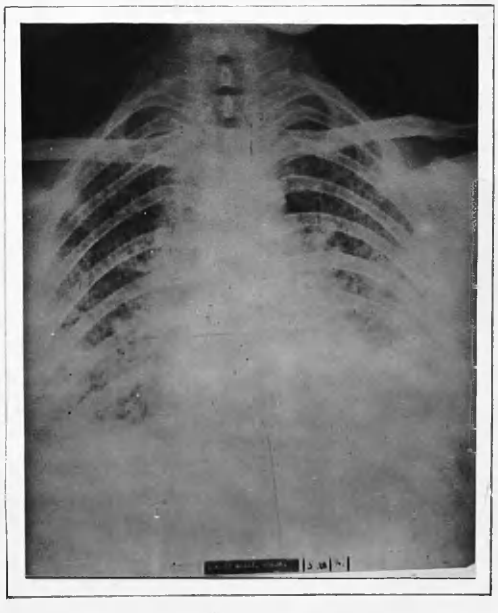


Fig. No. 88. The X-ray on the left was taken on 29.4.47 and shows marked increase in the number of opacities and the appearance of consolidation in both lower lobes. The X-ray film on the right was taken seven weeks later (5.6.47) and shows further progression of the condition.

Fig. No. 89. The preserved specimen. Note the presence of innumerable cystic spaces varying from several millimetres in diameter to 1.5 cm. in size. The lung has a fleshy appearance; very little normal lung remains.

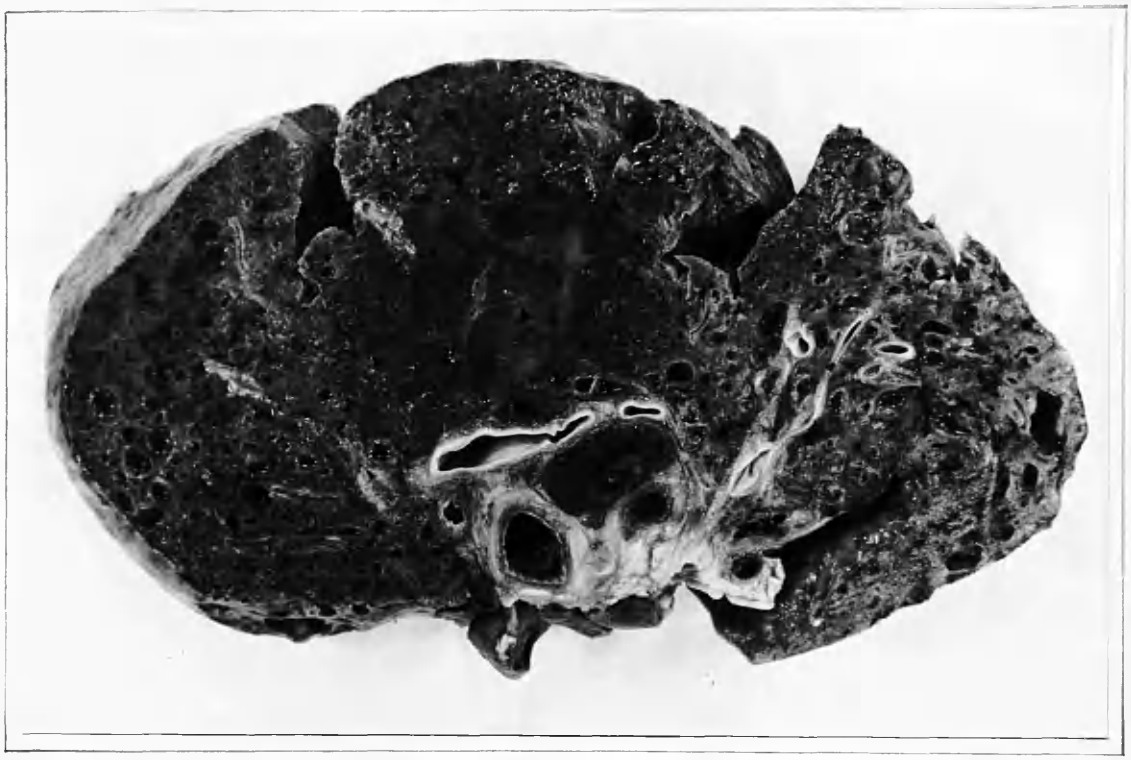
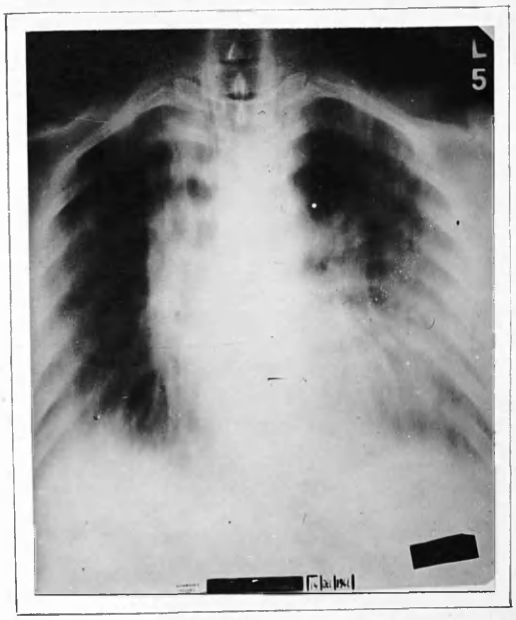
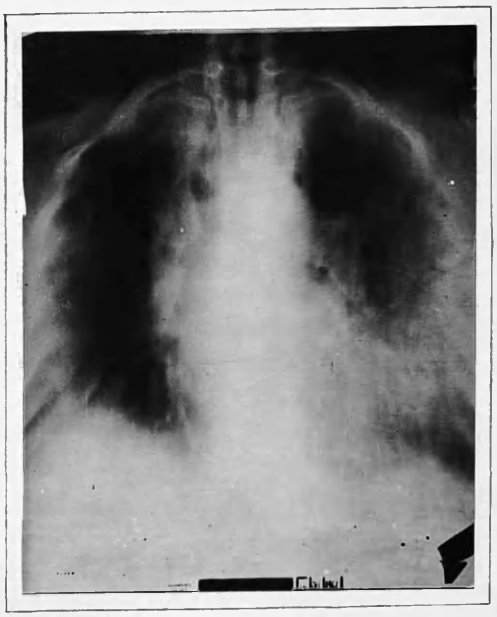
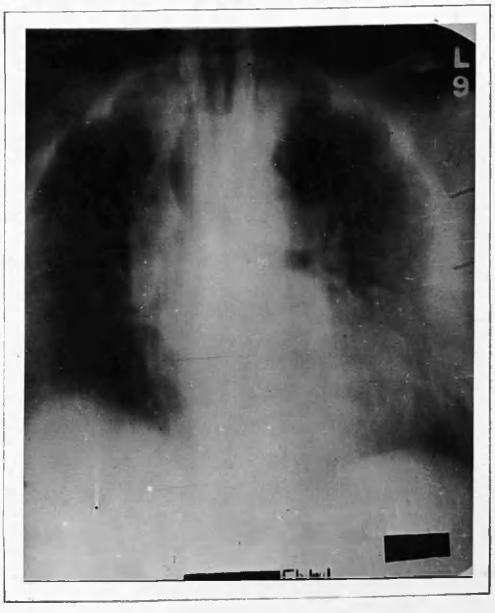


Fig. No.90. A further section of the same specimen.







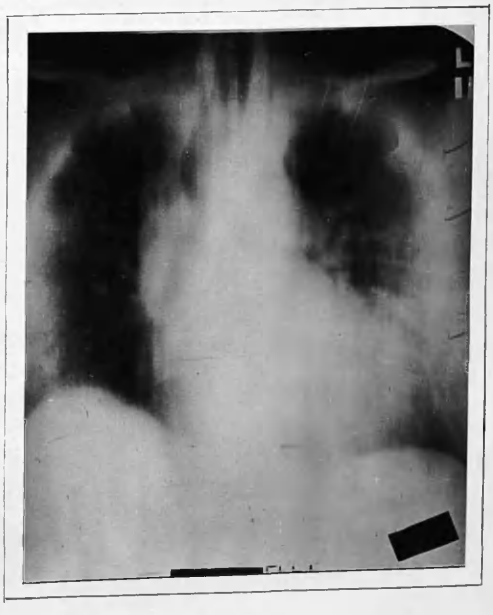
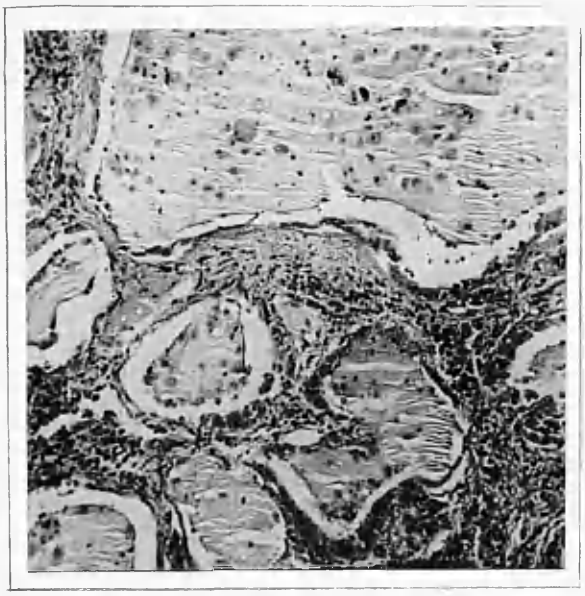
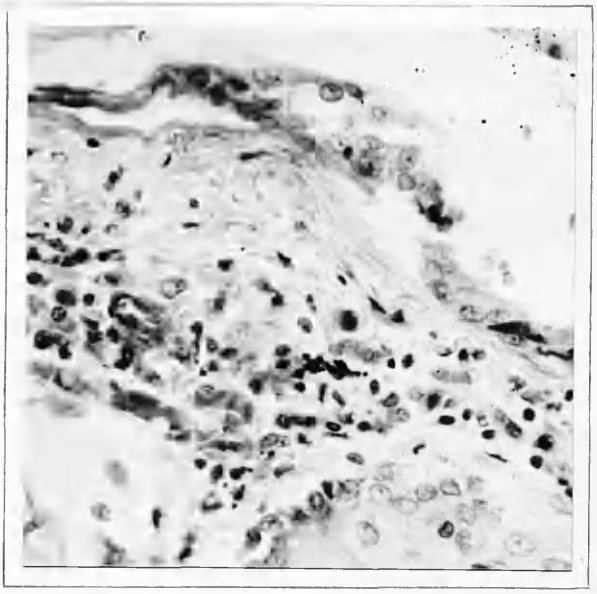
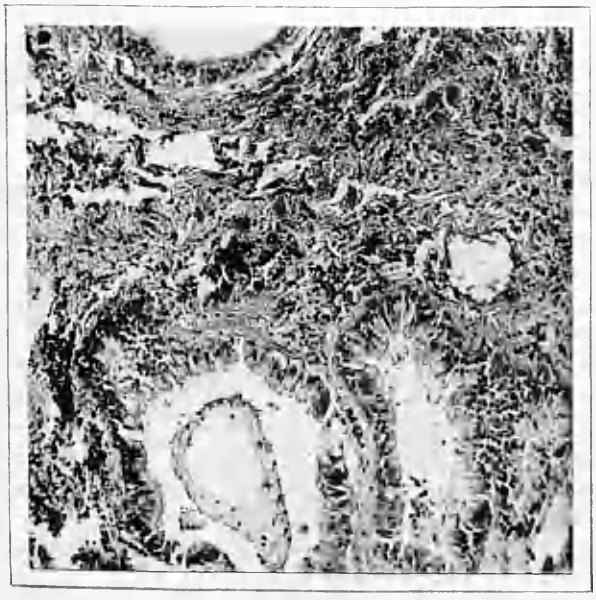


Fig. No.91. These tomographs were taken on 14.12.46. They show "cuts" at 5, 7, 9 and 11 cm. from the back and illustrate the diffuse extent of the lesions.







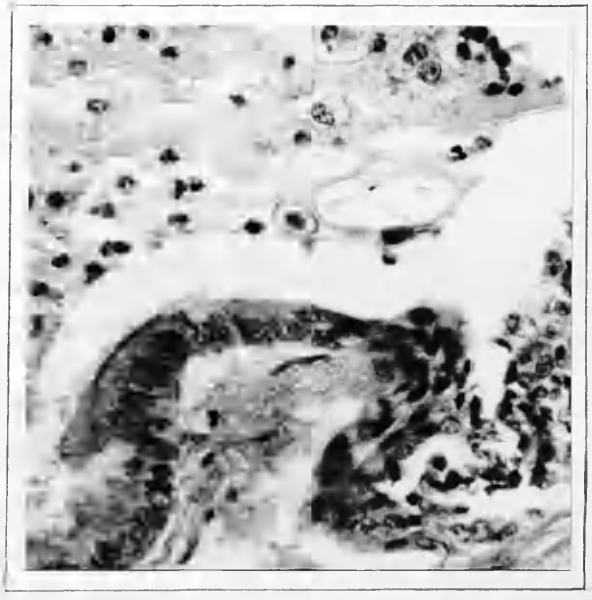


Fig. No. 92. Representative histological pictures. These show the multiple cystic spaces, lined by a single layer of cubical or low columnar epithelium. There is much fibrosis and inflammatory reaction.

Case No.31.

K.A. (51). Occupation - Inspector, Corporation Transport.

Admitted 17.12.47,

Dismissed 17.1.48.

Diagnosis Giant emphysematous bullous cysts of both lungs.

History. In 1915 he sustained a gunshot wound of the right chest following which he was in hospital for 6 weeks. Ever since that injury he had had increasing dyspnoea which had been severe since 1938. There had not been much cough or spit. He came to Hairmyres from the Glasgow Royal Infirmary where he had lived on almost continuous oxygen.

Examination. He was found to be orthopnoeic and cyanosed. There was no clubbing of his fingers.

Respiratory system. The chest was grossly emphysematous and distended and there was practically no respiratory excursion. All areas were hyper-resonant. Respiratory murmur was absent except at the left base posteriorly where it was harsh and anteriorly where there was faint amphoric breathing.

Cardio-vascular system.
Alimentary system. } No abnormality.

The patient was on continuous oxygen.

17.12.47. X-ray Report, Dr. R. Simpson. "Complete right pneumothorax. Partial left pneumothorax. The left lower lobe shows partial expansion".
19.12.47. Operation - Mr. Dick. "Right phrenic crush, under local anaesthesia".

Later in the day the patient felt somewhat improved.

21.12.47. X-ray Report, Dr. R. Simpson. "Following right phrenic crush there is little appreciable change to be noted on the right side. Re-examination of the left side shows what was taken to be a partial pneumothorax, is now seen to be enormous emphysematous bullae involving the whole of the upper half of left lung. A similar state of affairs may obtain on the right side but no linear shadow could be seen within the translucency here as on the left".
23.12.47. Operation - Mr. Dick. "Left phrenic crush, under local anaesthesia".

Almost immediately following the operation the patient became very cyanosed and orthopnoeic. This eased slightly on sitting up. Later in the day the cyanosis became gradually less marked.

24.12.47. He claimed that he felt easier and that his oxygen requirement was not so great.

31.12.47. His oxygen requirement was about half what had previously been necessary. He was feeling more comfortable.

8.1.48. He had not been so well during the past few days and his oxygen consumption had increased greatly.

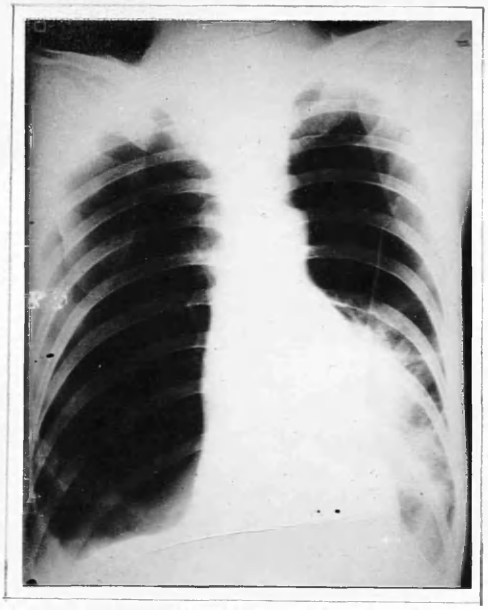
10.1.48. Operation - Mr. Dick. "De pezzer catheter inserted into the right side of the chest. Air escape under considerable pressure. Following this X-ray screening showed the right lung to be moving slightly on respiration".

12.1.48. He continued to blow air through his water sealed drainage.

17.1.48. Breathlessness increased during the course of the day and in the evening he became unconscious and died.

Post-mortem Report of Lungs, Mr. K. Fraser. "The left lung shows four bullae, the largest of which lies in what remains of the summit of the lung and after distension measures 18 cm. in diameter. One further bulla shows similar measurements, another 5½ x 5 cm. and one smaller.

The right lung shows a very large bulla which has been opened in the course of removal of the lung at post-mortem. The walls of the bullae are quite thin of dark grey cobweb appearance and faintly transparent. The lungs are quite collapsed and solid".



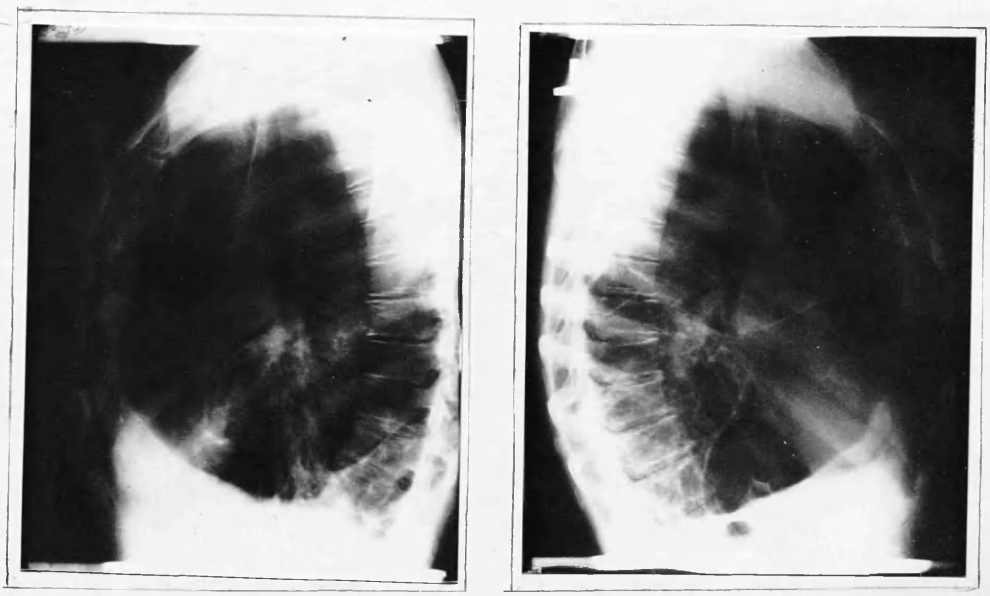
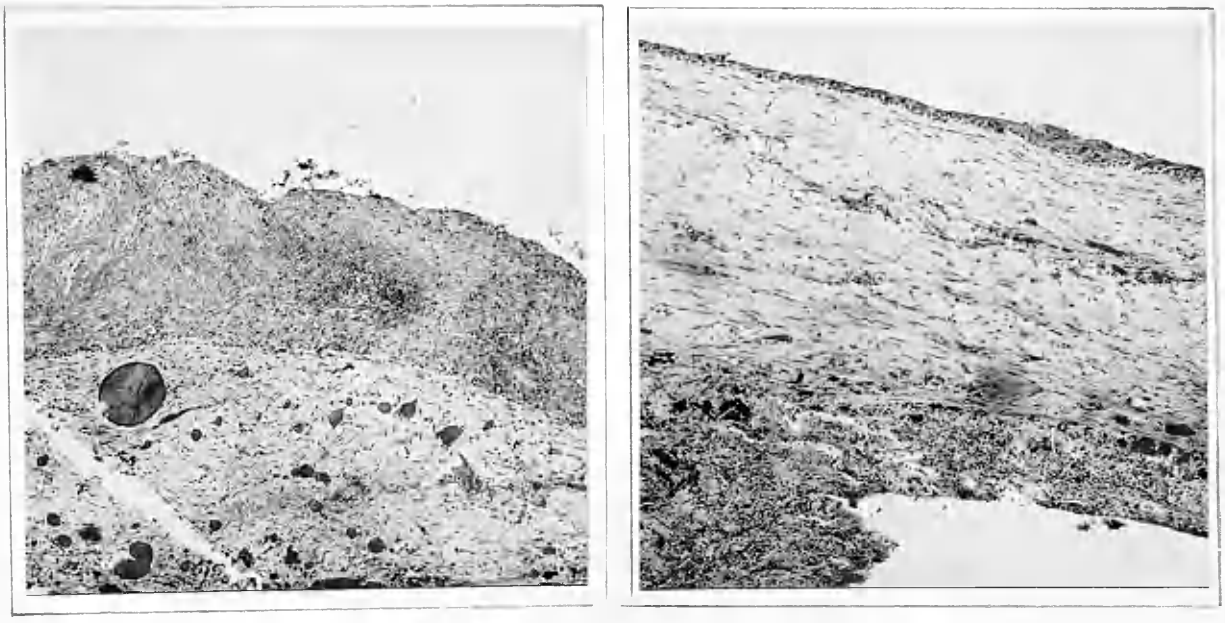


Fig. No. 93. The right hemithorax is completely filled by a large bullous cyst, the left is two thirds replaced by four bullous cysts. The diaphragms are displaced downwards.

Fig. No. 94. The preserved left lung. Four bullae can be seen sitting in a semi-circle on the top of the collapsed lung; after distension the largest bulla was 18 cm. in diameter. The lung occupies an insignificant place below the bullae.



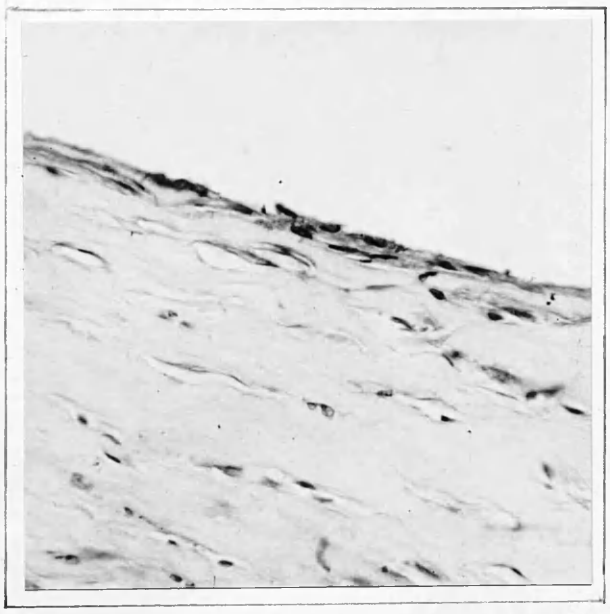


Fig. No. 95. Histological appearance of the cyst walls.

Case No. 32.

E.W. (46). Occupation - Postman Driver.

Admitted 8.9.48,

Dismissed 29.9.48.

Diagnosis Bullous emphysematous cysts of the lung.

History. For four years he had been breathless on exertion and for two years he had been breathless even at rest. There was no history of accident but he complained of cough and spit which was moderate in amount and occasionally contained a trace of blood. He had had pneumonia in 1940. In 1920 he had had rheumatic fever, following which he suffered from bronchitis. He had congestion of the lungs in 1926, pneumonia in 1940, and in 1945 he had had a spontaneous pneumothorax in Dundee Royal Infirmary.

His mother died of cancer at the age of 65; his father was alive and well aged 73.

Respiratory system. His chest was barrel shaped and showed limited expansion on both sides and it was noticed that his accessory muscles were in use even at rest. The percussion note and auscultation showed very little abnormality.

Cardio-vascular system.
Alimentary system. } No abnormality.

9.9.48. Examination of the respiratory system showed some impairment on percussion at the right apex where there was slightly diminished air entry. The apex beat was in the mid-clavicular line in the 6th left interspace. The first sound at the apex was obscured by a loud, rather harsh systolic bruit. The second sound was not heard.

10.9.48. X-ray Report, Dr. McKail. "Emphysema with bullous formation on the right side. This change involves both lower and middle lobes with giant bullae in the posterior part of the lower lobe".

15.9.48. His teeth were in bad condition and 7 of these were extracted; the remainder were removed on 22.9.48.

28.9.48. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Cyclopropane,
Curare.

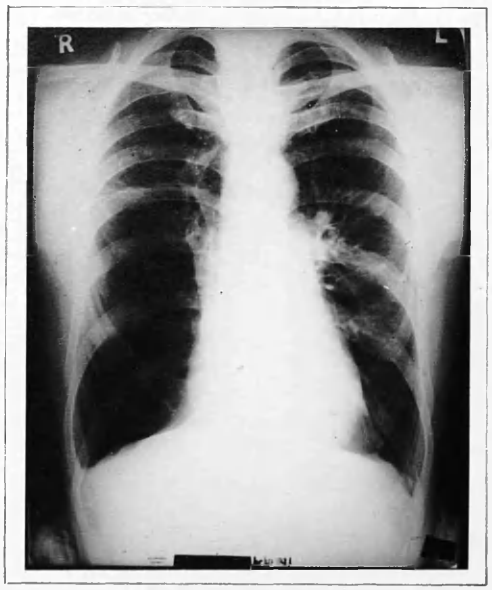
The patient ceased breathing after pentothal was given and during the subsequent course of the operation respiration required to be continued by controlled breathing by Dr. Pinkerton. Postero-lateral incision was used to open the chest.

A distended air filled cyst presented in the wound. This was opened and was dissected out. Three small bronchi were found to enter into the cyst which was ultimately removed from the lower lobe which was conserved. There were two other smaller cysts which were excised and the raw area was oversewn. One of these extended into the middle lobe. Before the chest was closed it was seen that the upper and middle lobes were expanding well but the lower lobe was rather reluctant to expand. The chest was closed.

He was retained in theatre for 1¾ hours after the operation while oxygen was given by endotracheal tube. The endotracheal tube was removed at 6.30 p.m. At 11 p.m. he became restless and lapsed into a coma with periodic breathing and long phases of apnoea. He was put on to coramine. At 12 midnight he had improved somewhat but was only responsive to strong stimuli.

His peripheral circulation became progressively worse and he continued to have apnoeic phases; he died at 6.30.

Pathological Report, Mr. K. Fraser. "After preservation, the cyst measured 10 x 7 cms. The whole cyst wall is smooth and shiny, except the area arising from the lobe of the lung where the wall has a cobweb appearance , some strands passing completely across the cyst."



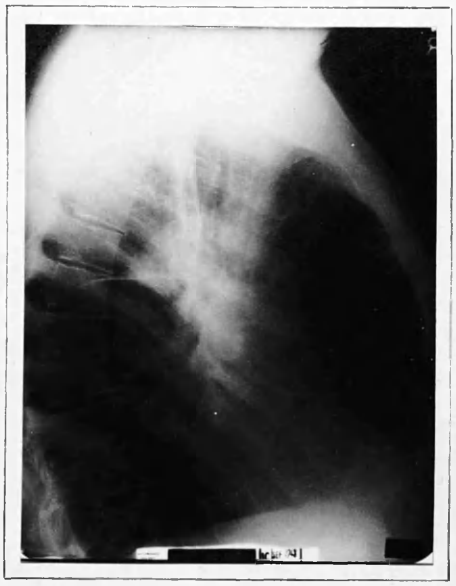


Fig. No. 96. Emphysematous bullous cysts in right middle and lower lobes. The postero-anterior X-ray film illustrates the long curving line formed by the mediastinal edge of such cysts - an important differentiating feature between cyst and pneumothorax!

Fig. No. 97. The preserved cyst after being dissected out from the lower lobe at operation.

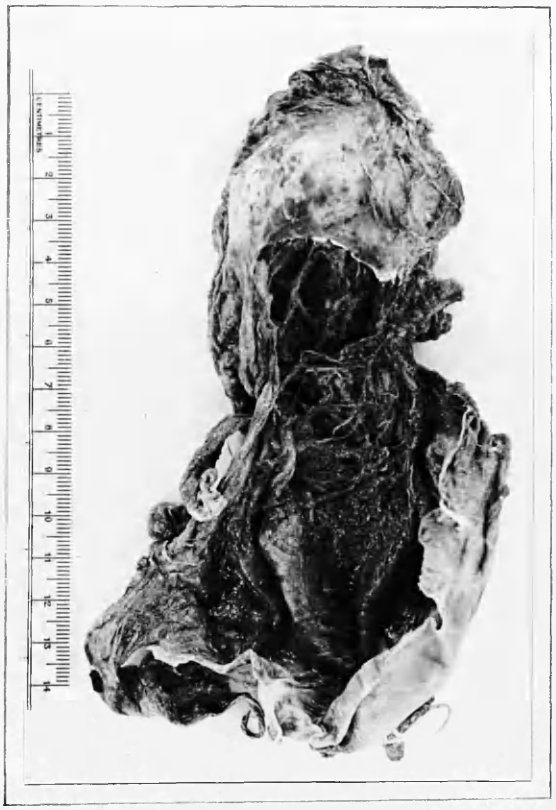
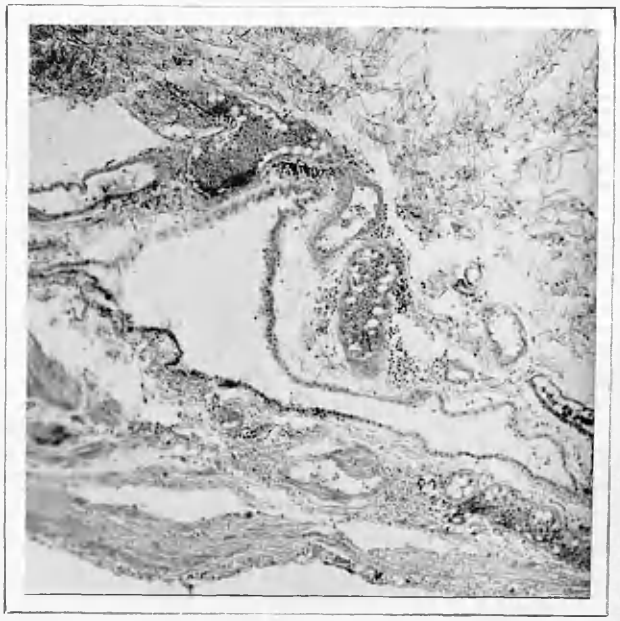
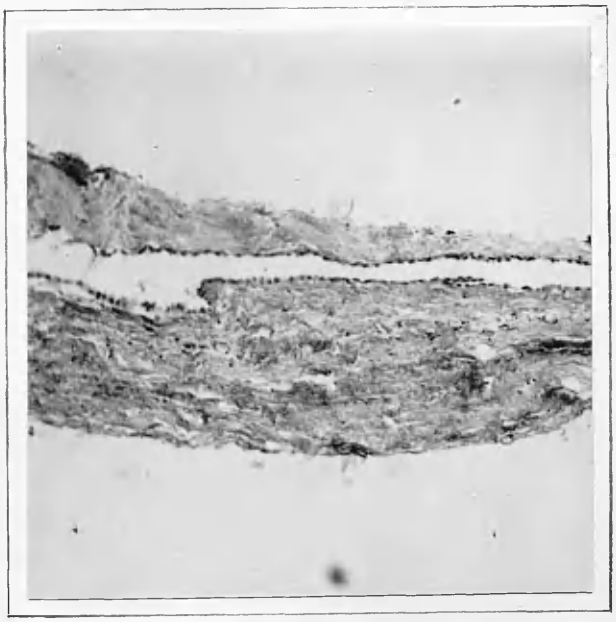


Fig. No. 98. The "cobweb" appearance seen within the cyst.





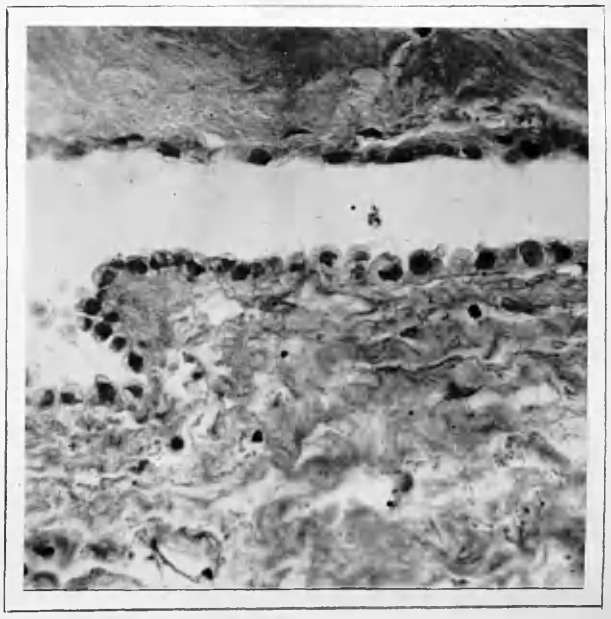


Fig. No.99. The cystic spaces are lined by cubical or flattened epithelium.

Case No. 33.

R.F. (14). Schoolboy.

Admitted 29.9.51,

Dismissed 16.1.52.

Diagnosis Emphysematous bullae of Lung.

History. He had been in good health until one year previous to admission when he noticed that he had giddy attacks and blurring of vision after exertion. He was thought to have anaemia and had treatment for this. He had no cough and spit and was never short of breath. He had lost a considerable amount of weight and was sometimes under 6 stone. On admission, he had reached 7 stone 2 lb. He had pain at times in the left side of his chest particularly on exertion; the pain was sharp and was relived by rest. He was easily tired.

Previous health. He had measles and whooping cough at the age of 5.

General examination. He was a very pale boy with bad posture. There was no clubbing of the fingers.

Respiratory system. Movement of the chest was poor and there was dullness at the left side of the chest where the respiratory murmur was reduced and rhonchi were heard after coughing. The right side was normal.

2.10.51. X-ray Report, Dr. Cuthbert. "Large emphysematous bullae are defined involving the lower, middle and dorsal segments of the left lower lobe. The lung fields otherwise remain clear and cardiac outlines are within normal".

24.10.51. X-ray Report, Dr. Cuthbert. "Lipiodol bronchogram reveals the changes of bronchiectasis in the lingular and anterior basal segments of the left lung. The remainder of the left lower lobe shows bullous emphysematous changes previously defined".

7.12.51. Operation - Mr. Dick, Mr. Fraser.
Anaesthetist - Dr. Pinkerton.

Face-down, head-down position. The chest was opened through the bed of the resected 7th rib. The left lower lobe was then seen to show large and extensive bullous formation throughout its entire lower aspect. These bullae looked rather like very large grapes and they were associated with the lower lobe and formed a continuous fringe along the foot of the lobe. The bullae were opened in several places with the intention of putting water over them to see if there was a communication with the bronchus but it was found on opening them that the bullae were really areas of rudimentary lung through which were passing

strands of lung and fibrous tissue so that from the external surface although they looked like cystic spaces, when opened they were not true cysts. Left lower lobectomy carried out. Wound closed with drainage.

10.12.51. Following operation he had refused to cough and required bronchoscopy. Following this, the lung began to re-expand.

16.1.52. He was dismissed well.

12.3.52. He has reported as an outpatient and had no cough or spit.

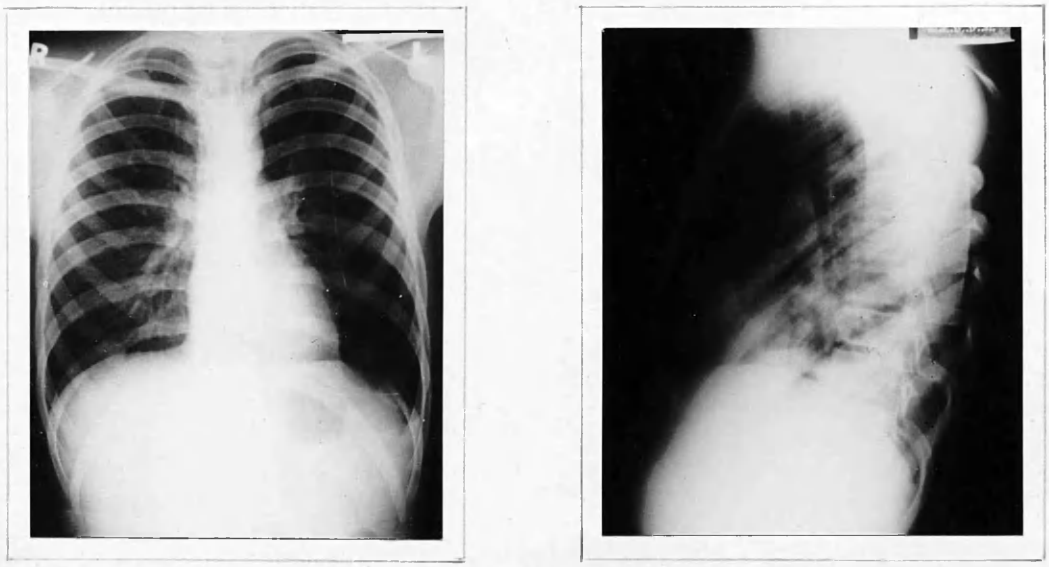


Fig. No. 100. Large emphysematous bullae involving the entire left lower lobe. The left lower lobe is almost free of lung markings. Note the air shadow overlapping the left diaphragm.

Case No.34.

C. McL. (29). Occupation - Domestic Servant.

Admitted 10.5.49.

Dismissed 11.7.49.

Diagnosis Pulmonary and hepatic hydatid cysts.

History. Seven weeks prior to admission she began to complain of gradual shortness of breath on walking uphill accompanied by pain. During the same time, she noticed a slight discomfort in the right chest on exertion. She had had no cough or sputum and there had been no loss of energy or weight. She had had no difficulty in swallowing. She says her appetite was not good but she had no indigestion. She was a domestic servant and worked in a hotel.
She did not come in contact with animals.

Examination. She looked well. Colour pale. No clubbing of fingers.

Respiratory system. Both sides moved equally. The percussion note was resonant throughout both lungs. The respiratory murmur was vesicular throughout and no adventitious sounds were heard. Vocal resonance and vocal fremitus were unchanged. Abdomen showed the liver to be palpable two fingers breadth below the right costal margin.

12.5.49. X-ray Report, Dr. Munro. "There is a large spherical opacity 10 cms. in diameter in the right lower hemithorax. It lies centrally in the lateral view and in the postero-anterior view seems to be adjacent to the lateral chest wall. Its margin is sharply defined and the lung fields otherwise show no evidence of active pulmonary disease.

The appearances suggest a simple tumour, probably cystic in nature. Screening to confirm that the mass is entirely intra-pulmonary and to determine the presence of Escudero-Nemenov sign would be helpful".

16.5.49. Casoni test doubtfully positive.

28.5.49. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Cyclopropane.

The right chest was opened. The lung was free of adhesions but the fissure between the lower and middle lobes was almost obliterated. The cyst in the lower lobe could be seen superficially under the lung as a white swelling tense to the touch. Dissection was commenced posteriorly and the lower lobe bronchus was displayed and clamped. The inferior pulmonary vein was next doubly ligated and transfixed.

The bronchus and the vein were then divided.
Dissection was carried out in the fissure between lower and middle lobes, then the artery to the lower lobe was secured. While this was being done, the adventitious lining of the cyst gave way, the cyst herniated itself intact from out of the lower lobe.
The lower lobe artery was divided and the lobe removed.
The cyst was then lifted out intact.
Penicillin-sulphathiazole instilled, drainage tube inserted and wound closed.
The specimen consisted of a sphere 3" in diameter with a white glistening hilar shell and filled with fluid.
On rupturing the cyst its wall everted itself.
The fluid was yellow in colour and contained numerous yellow-brown granules ?hydatid sand.
21.5.49. The cyst fluid was examined by Mr. Fraser and scolices were seen.
4.6.49. The right chest was aspirated and 900 c.c. of crystal clear fluid withdrawn. There was more fluid still to come. This aspiration caused some surprise as to the quantity of fluid present.
4.6.49. Later that evening the patient developed symptoms which were suggestive of an anaphylactic phenomenon with migraine, aphasia, weakness of face etc.

11.6.49. The chest was again aspirated and a further 600 c.c. of thin yellow fluid removed.

13.6.49. X-ray now revealed the presence of a second cyst lying below the right diaphragm.

21.6.49. Operation - Mr. Dick, Mr. McCluskie.
Dr. Pinkerton -
Pentothal,
Cyclopropane.

Incision was made along the length of the 12th rib which was resected along with a portion of the 11th. Peritoneum was opened over the liver and a large white cyst 6" in diameter came into view in the superior aspect of the liver lying immediately below the liver capsule. A needle was inserted into the cyst. Hydatid fluid was withdrawn and 10% formalin injected. The cyst was opened, fluid sucked off and the collapsed endocyst removed. The incision in the ectocyst was closed, peritoneum was sutured and the wound was not drained.

Royal College of Physicians Laboratory Report.

No.8569/3336. Dr. McGregor. "A. The wall of the cyst consists of dense fibrous tissue heavily infiltrated with inflammatory cells and containing the remains of liver cells with a necrotic inner zone, presumably where the cyst wall lay against the membrane.

"B. Fragments of membrane showing the characteristic laminated structure of a hydatid cyst. No scolices seen".

Apart from a mild degree of peritonitis which might have been due to the irritation of formalin, she made a good recovery.

10.7.49. She was allowed home.

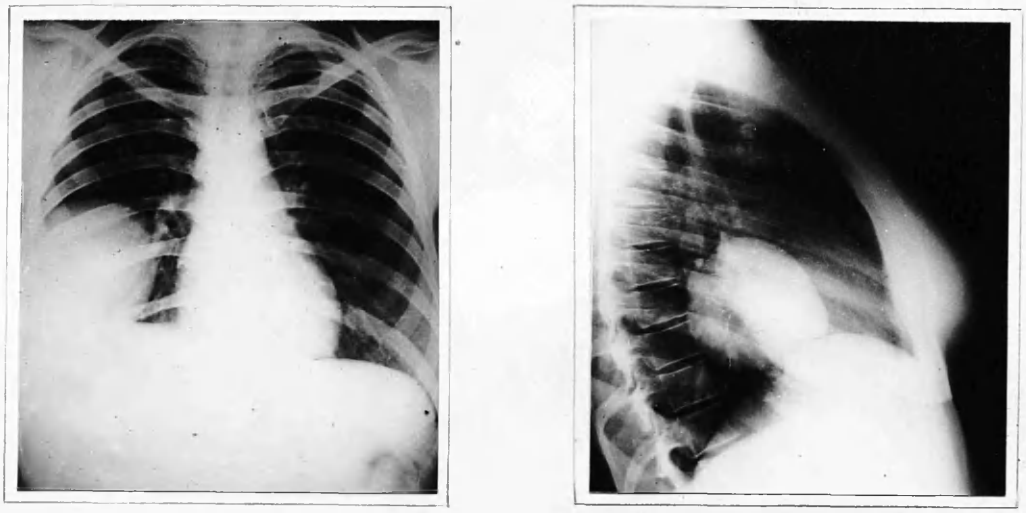


Fig. 101. The hydatid cyst in the right lower lobe. Note the elevation of the right diaphragm due to a large liver hydatid.

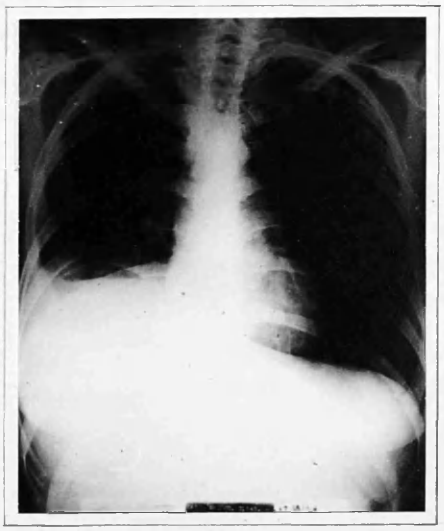


Fig. 102. X-ray appearances after removal of the lung hydatid and after the aspiration of 900 c.c. of fluid from what was believed to be the pleura but which was in fact from the undiagnosed liver hydatid. A fluid level is seen in the liver hydatid.

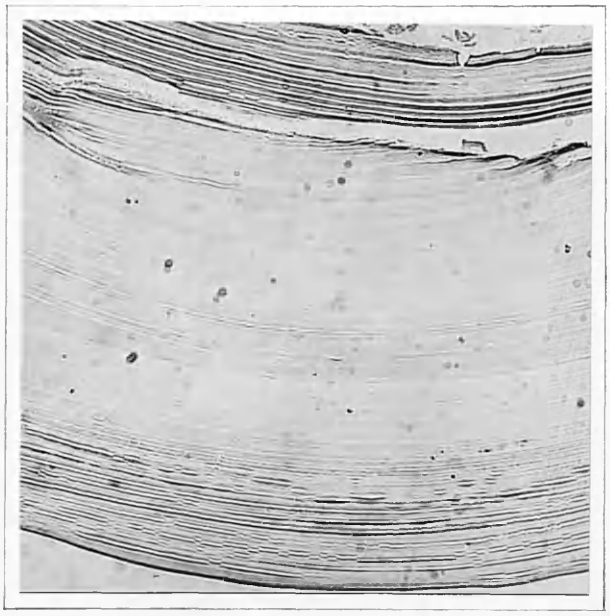


Fig.103. The histological picture of the cyst wall. No cyst lining could be demonstrated and only this chitinous endocyst was found.

Case No.35.

W.K. (47). Occupation - Banker.

Admitted 13.5.46.

Dismissed 2.8.46.

Diagnosis Hydatid cyst of lung.

History. For three or four years he had been troubled with a slight cough accompanied by scanty mucoid sputum. On one occasion in 1945 he had had several small haemoptyses all during the one day. He had not had haemoptysis previously nor has he had it since. There had been no dyspnoea.

In April 1945 following an attack of bronchitis he had his chest X-rayed, when an opacity was noticed in the upper part of the right lung. He was sent home from Persia where he had been for 27 years, and during which time he had had good health. His appetite was good, his weight was steady and he had led an active life.

There had always been several dogs about the house, which is the usual state of domestic life in Persia.

Previous history. No relevant disease.

General examination. He was a middle aged man of healthy appearance with no cyanosis, no engorgement of veins and no clubbing of the fingers.

Respiratory system. Chest was symmetrical and moved equally on respiration. The percussion note was impaired anteriorly over the upper 3rd of the right lung. Respiratory murmur was vesicular and equal throughout. The vocal resonance was equal on both sides and no adventitiae were heard.

Cardio-vascular system and other systems showed no abnormality.

15.5.46. Diagnostic pneumothorax was carried out on right side and 750 ccs. of air were put into the chest, 550 of which were withdrawn after X-ray.

15.5.46. X-ray Report, Dr. McKail. "There is a lobulated mass with sharply defined margins measuring 7.5 x 7.5 cms. situated in the pectoral portion of the upper lobe of the right lung. On 22.4.45 the measurements were 7 x 6 cms. The appearances are most probably due to a bronchogenic cyst".

17.5.46. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton - Pentothal, Cyclopropane.

The chest was opened by the usual right oblique incision. The cyst was found to be lying in the inferior part of the upper lobe in the right lung, and it was centrally placed in an antero-

posterior direction. It was adherent at one point to the chest wall anteriorly. This area was freed and in pressing the lobe the cyst burst and the cyst lining immediately extruded itself. This lining was removed and the cyst was shelled out. A large cavity remained in the upper lobe, which cavity was found to communicate with a bronchus. This cavity was closed by a series of purse string sutures and the chest was closed.

Pathological Report, Mr. K. Fraser. "This shows a white swelling 4 cms. x 2 cms. of oval shape. The cyst wall is membranous and semi-translucent. Many small egg like structures are lying on its inner aspect.

Cyst fluid. This is teeming with hydatids in all stages of development. Once the cyst fluid had dried on the slide innumerable hooklets of uniform and characteristic shape were seen".

Many attempts were made to make microscopic sections of the cyst wall but these were unsatisfactory due to shredding of the tissue. Dense collagenous fibrous tissue formed the outer layer of the cyst wall.

12.6.46. The wound was completely open and discharging. He had suffered from breathlessness due to bronchitis and required a steam tent which helped him greatly. He suffered from no anaphylactic phenomenon in spite of the spilling at operation.

2.8.46. He was discharged home. The wound was almost healed.

20.11.51. He has reported at frequent intervals. He is now considerably incapacitated by breathlessness and asthmatic attacks. He now suffers from a "lattice lung" and broncho-pleural fistula.

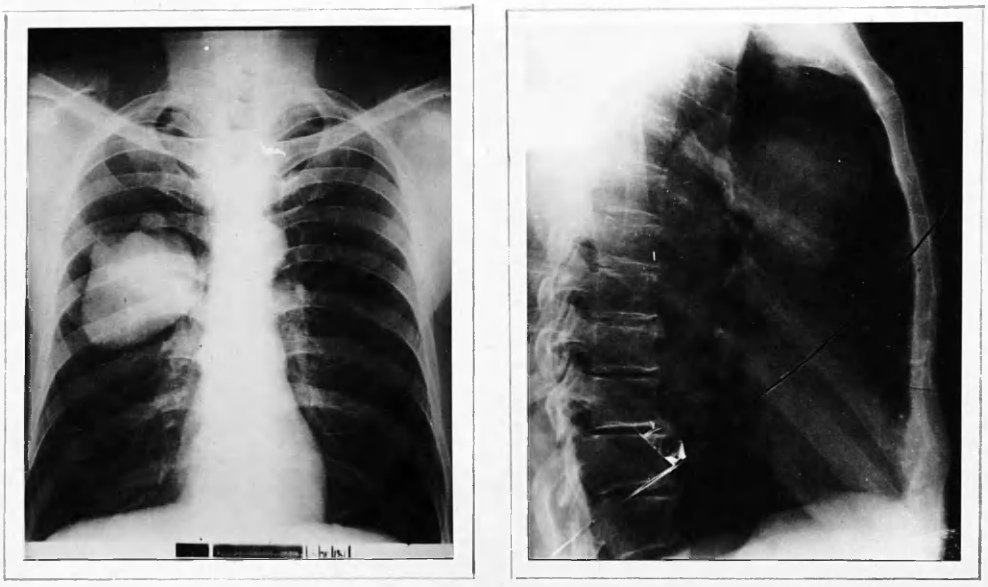


Fig. 104. X-rays showing the hydatid cyst in the anterior segment of the right upper lobe. They illustrate the curious lobulated appearance; the lateral view resembles a clover leaf.

Fig. No. 105. A portion of the wall of the hydatid cyst.

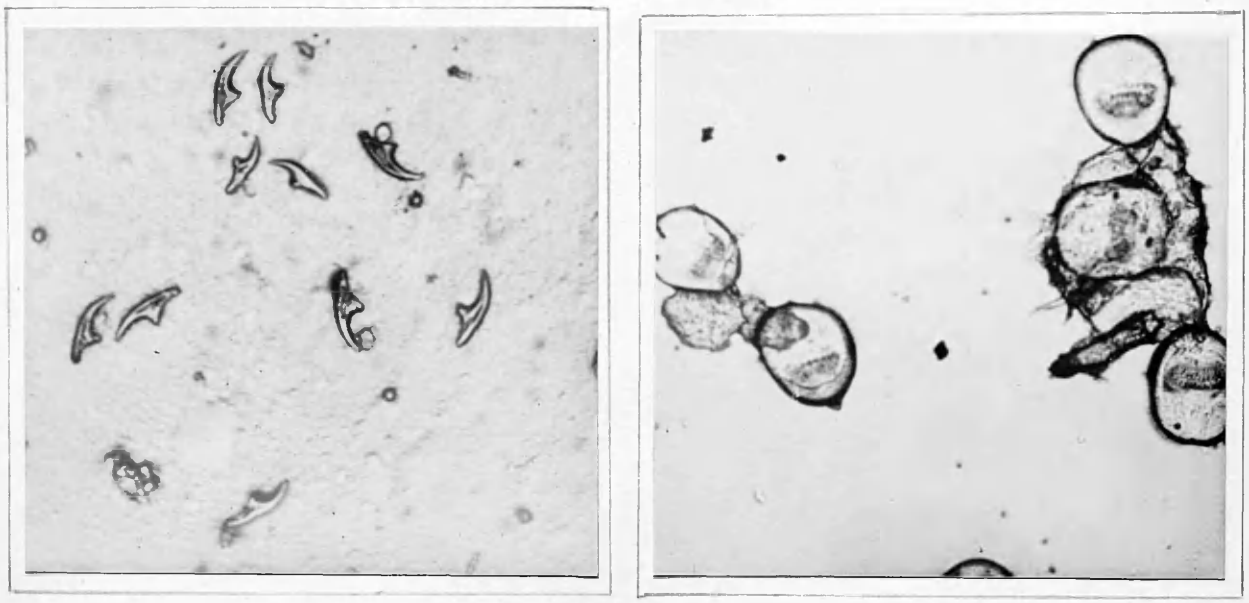


Fig.106. The picture on the right records abundant scolices in the hydatid sand; the one on the left shows the detached hooklets which are of such diagnostic importance.

Case No. 36.

E.W. (11). Occupation - Schoolgirl.

Admitted 11.3.46.

Dismissed 2.5.46.

Diagnosis Hydatid cyst of mediastinum.

History. For some months she had complained of a short irritating cough accompanied by very little sputum. The cough was no worse at any particular time but persisted throughout the day. There was no breathlessness and no haemoptysis. Her previous health had been excellent and there was no history of any respiratory disease.

On examination, she was found to be a well built little girl, of good colour.

Respiratory system. There was no abnormality on inspection but there was an area of impaired resonance on the right side posteriorly medial to and at the level of the superior angle of the scapula. Further examination revealed no abnormality.

The other systems showed no abnormality.

12.3.46. X-ray Report, Dr. McKail. "There is a well defined ovoid opacity of homogeneous density, approximately 5 x 3.5 cms. in size, lying in the

angle between the trachea and the right main bronchus posteriorly. The appearances are those of a bronchogenic cyst".

27.3.46. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton - Pentothal, Cyclopropane.

The chest was opened by the usual postero-lateral incision. The lung was found to be almost completely adherent to the pleura as a result of an old empyema. Adhesions over the upper half of the lung were stripped away and a firm smooth cyst, the size of a golf ball, was felt alongside the trachea just above its bifurcation. It was adherent to the mediastinal aspect of the right lung.

On retracting the lung the cyst detached itself completely from the trachea and was removed intact. The chest was closed.

Pathological Report, Mr. Fraser. "This is a white semi-translucent egg-like cyst measuring 5 cms. x 4 cms. in size. When the cyst was opened it collapsed as clear watery fluid amounting to 1½ ounces in quantity escaped. No cholesterol crystals were seen in the fluid.

Histological sections were difficult to make as the wall of the cyst tended to disintegrate. The outer layer of the cyst wall consisted of dense collagenous fibrous tissue. The mucous membrane lining was a syncytium of cytoplasm dotted with tiny nuclei.

The histology was kindly seen by Professor Cappell and Dr. Niven who agreed that the appearances were unlike human tissue histology and it seemed that the cyst was almost certainly a hydatid cyst. A careful search was made for hooklets in the cyst wall but none could be found".

5.4.46. She was very well and was up and about, although the lung was slow to re-expand.

2.5.46. Allowed home. Lung nearly completely re-expanded.

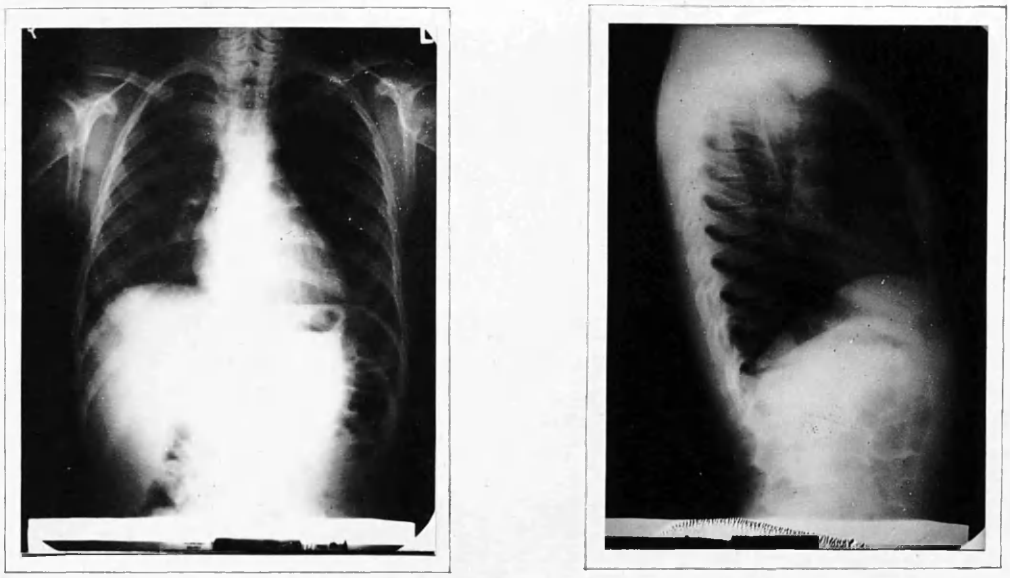


Fig.107. The small hydatid cyst can be seen in the superior mediastinum projecting to the right at the level of the inner end of the right clavicle. The lateral x-ray shows the cyst shadow superimposed on the outline of the trachea.

Fig.108. The cyst filled with cotton wool and as it appeared after the shrinkage natural to fixation.

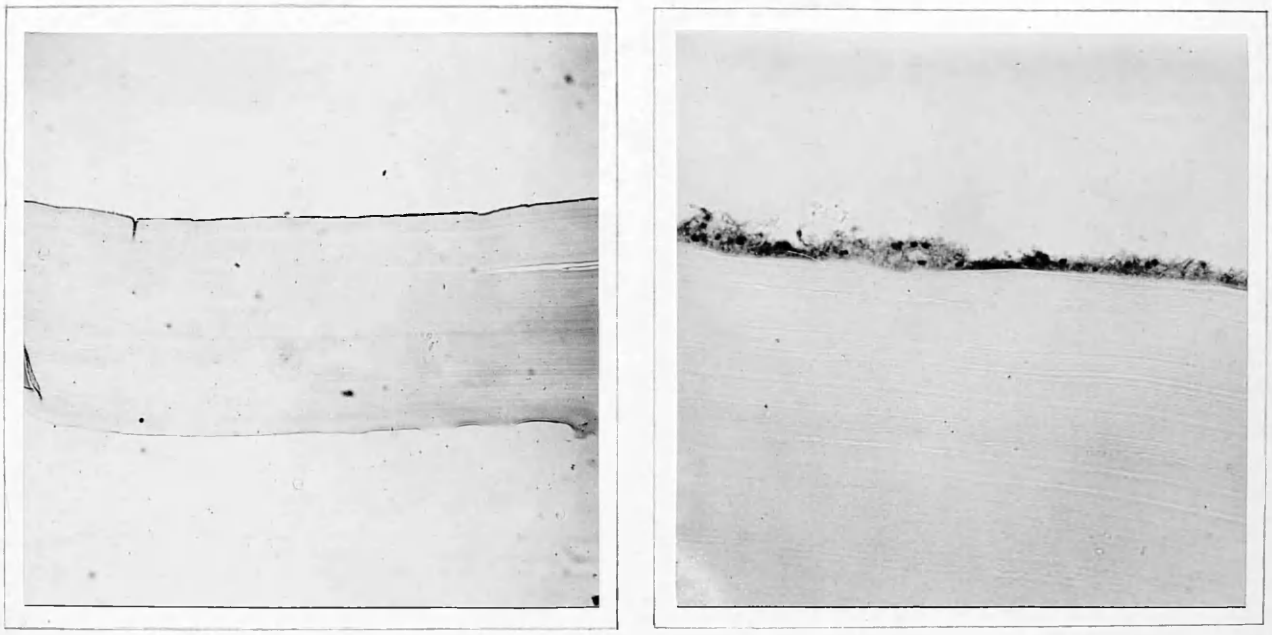


Fig. 109. Low and high power microphotographs of the cyst wall. The dense chitinous outer layer is seen lined by a syncytium which is dotted with tiny nuclei.

Case No. 37.

D.H. (43). Occupation - Joiner.

Admitted 30.5.49,

Dismissed 16.7.49.

Diagnosis Haemangioma of lung.

History. He was very well until June 1948, when he began to complain of loss of energy and loss of weight, feeling easily tired and off colour. He also had tightness across the front of his chest but this was uninfluenced by exertion. He had always had a chronic cough with occasional spit. In September 1948 he noticed that he was coughing up blood stained sputum but did not bother much about this, as he had been having occasional nose bleedings for many years. In November 1948 he had a brisk haemoptysis of 2 pints and was admitted to Ballochmyle Hospital in a critical condition. No cause was discovered for this haemoptysis and he was discharged in January 1949. He started work but he had a further haemoptysis and he consulted Dr. Boyd at Irvine Central Hospital, where he was bronchoscoped. The bronchoscopy report was as follows:-

"The findings were telangiectatic lesions under the tongue, on the roof of the mouth and on the epiglottis. Trachea and bronchi appeared normal, except for what

appeared to be blood clot adherent to the anterior wall of the left lower lobe bronchus. This for obvious reasons was not disturbed".

He continued to have further haemoptyses, until he was admitted on 30.5.49. For over 20 years he had had small telangiectatic spots on face, hands and fingers, but not on his trunk. They bled easily.

Examination. He was found to be in fair condition. There was marked clubbing of the fingers and early clubbing of the toes. Telangiectatic spots were present on his face, mainly circumoral, inside his mouth and on the gums.

Respiratory system. Little or no abnormality could be detected apart from some harshness of the respiratory murmur throughout both lungs.

His other systems were normal and his blood picture was within normal limits.

31.5.49. X-ray Report, Dr. Munro. "There are a number of small, circumscribed rounded opacities in the left lower zone, which were seen in the lateral view to lie in the left lower lobe. There is a similar small opacity in the right lower zone at the level of the diaphragm. In the lateral view a number of similar opacities are seen in the anterior costo-phrenic angle.

Many of these opacities appear to have a translucent centre.

The appearance is unusual and does not suggest either tuberculosis or secondaries. It is possible that they represent vascular malformations of the nature of haemangiomata".

17.6.49. Bronchoscopy, Dr. Semple. "Trachea, carina and both stem bronchi normal apart from occasional minute dilated angiomatous submucosal vessels. All orifices well seen and normal.

Haemangiomatous changes were seen if anything most marked in the right side, especially at orifice of right middle lobe".

25.6.49. Operation - Mr. Dick, Mr. McLuskie.

Dr. Pinkerton - Pentothal, Cyclopropane.

The left chest was opened through the usual postero-lateral incision, resecting the 7th rib. The lung was quite free of adhesions and appeared normal to inspection. On compressing the lower lobe between the fingers, a small soft mass could be felt near the junction of the apical and posterior basal segments. This mass could be felt to pulsate and on auscultation over it a thrill was heard. The vessels of the lower lobe were controlled by digital

compression at the hilum and the mass undercut by a series of catgut sutures. The portion of lung containing the mass was then excised and the raw area closed by tying together the catgut sutures. No haemangioma could be detected elsewhere in the lung. The chest was closed in the usual way.

27.6.49. Royal College of Physicians Report, Dr. Lees. "There are two types of tissue to be distinguished. There is lung tissue which seems normal except that the alveoli contain many haemorrhages. There are more solid areas which lie raggedly and irregularly in the lung tissue and which together occupy about half the area of lung section. The picture of these solid areas is as follows:- Some of the pattern is confined by alveoli, that is, apparently lung alveoli, lined, however, by cubical cells which have not probably ever been capable of aeration. There are more solid areas with an endothelioid pattern. At least I think such was discerned. There is a definite excess of small arteriolar blood vessels, probably also of angiomatoid capillaries. The whole pattern is obscured by masses of haemorrhages, that is macrophage like cells packed with blood pigment granules and even red blood corpuscles.

The diagnosis is conformable with an angiomal

endotheliomatosis of lung with hereditary haemorrhagic telangiectasis".

16.7.49. He made a satisfactory recovery and was discharged home.

He reported at regular intervals and had had no further haemorrhages and had put on a great deal of weight.

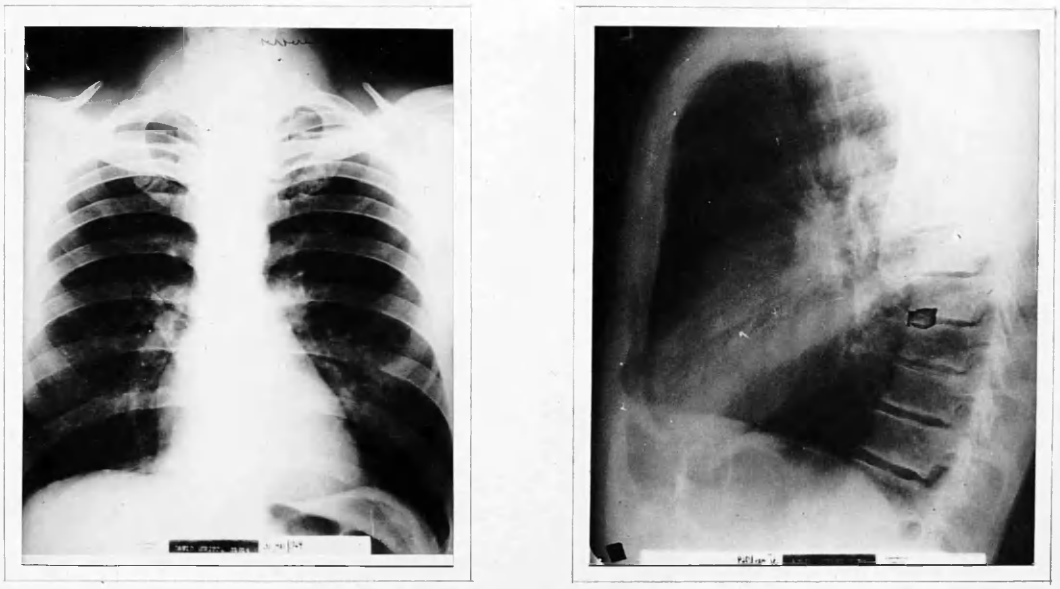


Fig. No. 110. Haemangioma in left lower lobe; in the lateral X-ray film the vascular malformation is seen as an opacity below and in front of the artefact on the X-ray film.

Case No. 38.

M.H. (59). Occupation - Nursery and Hostel Attendant.

Admitted 22.6.42, 25.5.43,

Dismissed 7.12.42. 13.11.43.

Diagnosis Polypoidal adenoma of bronchus.

History. For six months prior to admission she had had pain in the left side of her chest accompanied by cough and spit; in addition, she had complained of lassitude. On 20.12.41 she developed a left-sided dry pleurisy and she was three months in bed. Since then she had felt tired and had intermittent aching pain in the posterior region low down in the left chest. There had been no haemoptysis, breathlessnes or loss of weight.

Previous health. She had had a left-sided pneumonia in 1938.

Examination. She was in fairly good condition. Her colour was good and there was no loss of weight. There was slight clubbing of the fingers.

Respiratory system. There was dullness over the lower lobe of the left lung. Respiratory murmur was poorly heard over this area but vesicular in character. The vocal resonance was diminished.

Bronchoscopic examination, Dr. Gavin Young. "There is

a rounded, firm pallid growth blocking the left lower bronchus. Biopsy".

The histological report stated that the tumour was an oat-cell carcinoma.

Cardio-vascular system. No abnormality. B.P.165/95.

22.6.42. X-ray Report, Dr. Hurrell. "Left lower zone shows old lipiodol. Left base shows general opacity, suggesting pleural thickening".

23.6.42. X-ray Report. "A lateral film shows a wedge shaped area of consolidation and breakdown cavitation in the area of the posterior bronchial branch of the lower lobe bronchus. The right is covered by the heart in the A.P. view. Cause could be bronchial carcinoma, but is not seen in the present films".

2.7.42. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Chloroform,
Gas & Oxygen.

Left thoracotomy. A hard mass near the apex of the lower lobe was felt. The vessels and main bronchus were ligated and divided. The whole lung was removed because of extension of disease up to the hilar area. The wound was closed.

During the operation the blood pressure never

fell below 145/90. Two pints of blood were given following the operation.

3.7.42. 549 c.c. of dark blood aspirated from the chest. A monaldi catheter was inserted and attached to continuous suction. She was given a course of sulphadiazene.

29.7.42. She was allowed up.

4.10.42. The monaldi catheter was removed and a small tube was inserted.

7.12.42. Allowed home.

25.5.43. Re-admitted. She had had incfeasing shortness of breath and was easily tired.

29.9.43. Operation - Mr. Fraser. Dr. Pinkerton - Pentothal, Cyclopropane.

Two rib segments were resected above the site of drainage and a wide tube was inserted into the cavity. The previous drainage track had become "bottle necked" and ceased to drain.

Following this she made satisfactory progress and was allowed home on 7th December, 1943.

This case was reported in the "Glasgow Medical Journal" by Dr. Riddell Campbell and Dr. M.G.B. McLetchie, who reported the pathology as follows:-

"The upper lobe was normal. The lower lobe

was shrunken, due to fibrosis, and its pleura showed moderately generalised fibrous thickening, with adhesions to the upper lobe. The main bronchus of the lower lobe was dilated and was occluded by a firm, hard polypoid tumour having a smooth surface. The tumour was attached to a puckered area of bronchial wall about ½ cm. in diameter and extending 1.5 cm. in both directions along the bronchus. In its proximal part it collected in several small bundles into the orifice of the two main branch bronchi to the lower lobe. The apex of the tumour did not reach the orifice of the major branches of the upper lobe. The main bronchus below the tumour and the two occluded branch bronchi showed a uniform cylindrical bronchiectasis.

Histology.

The tumour had a covering of columnar epithelium with a well defined basement membrane in continuity with the epithelium of the bronchus. There was a thick layer of connective tissue between the basement membrane and the underlying tumour tissue in some areas. No ulceration was present. The tumour tissue proper, roughly loculated by fibrous strands, consisted of a level mass of small oval cells showing relatively large nuclei, and only a rind of cytoplasm. The cell

structure was similar to that present in oat-cell carcinoma, except that more vesicular than hyper-chromatic nuclei were present and the nuclei were more uniform in appearance. No mitoses were present. Cells showed no uniform arrangement. The bulk of the tumour was made up of a smaller mass with scanty stroma and scanty thin walled blood vessels, showing no definite pattern. A few small areas were highly vascular, with the tumour cells cuffing the blood vessels, giving the appearance of complex papilloma. Reticulum fibres were, in most areas, confined to a few irregular strands and appeared as a cuff around the blood vessels. There was no true gland like architecture. At the site of origin of the tumour the bronchial wall was replaced by bands of connective tissue within, and a few strands of tumour cells lay in clefts. Areas of recent haemorrhage were present throughout the tumour. What has been lung tissue showed variously fibrosis, collapsed lung tissue and spaces lined by cubical epithelium, packed with foamy phagocytes. Fibrosis was especially marked in the region of the tumour pedicle. The hilar lymph glands, except for infiltration with fresh red blood corpuscles, were healthy.

The authors point out the difficulty there is

in diagnosis in such a case, from a biopsy specimen, and in fact, in this case, the diagnosis of "oat cell carcinoma" was made in error".

17.12.46. She has reported frequently and reported today, when she was found to be extremely well.

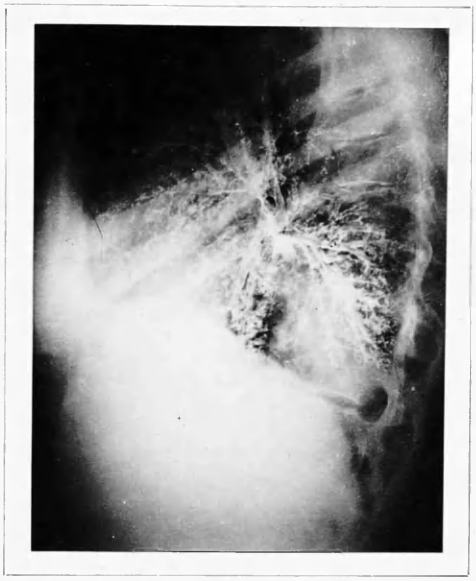


Fig. No. 111. Lateral lipiodol X-ray film showing blockage of the stem bronchus just below the upper lobe orifice. All segments of the upper lobe are well filled with lipiodol.

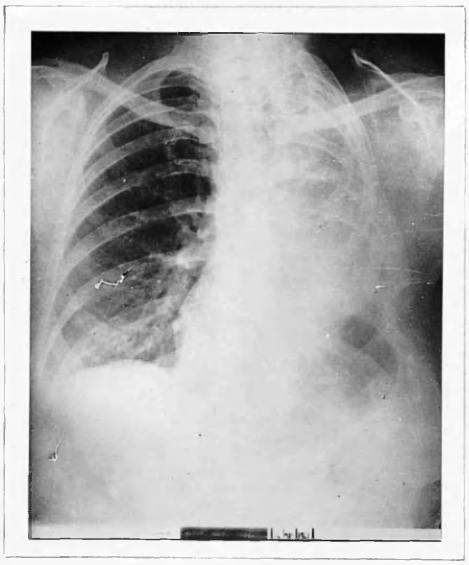


Fig. No. 112. X-ray film four years after pneumonectomy. The capacity of the left hemithorax is greatly reduced the result of inward collapse of the chest wall, deviation of the mediastinum to the left (note the displacement of the trachea) and elevation of the left diaphragm (the result of intentionally produced phrenic nerve paralysis at the time of operation).

Fig. No. 113. The lung has been cut longtitudinally. The tumour fills the stem bronchus and reaches upwards to just below the upper lobe orifice which can be seen as a dark recess just above the tumour. There is gross lower lobe bronchiectasis.

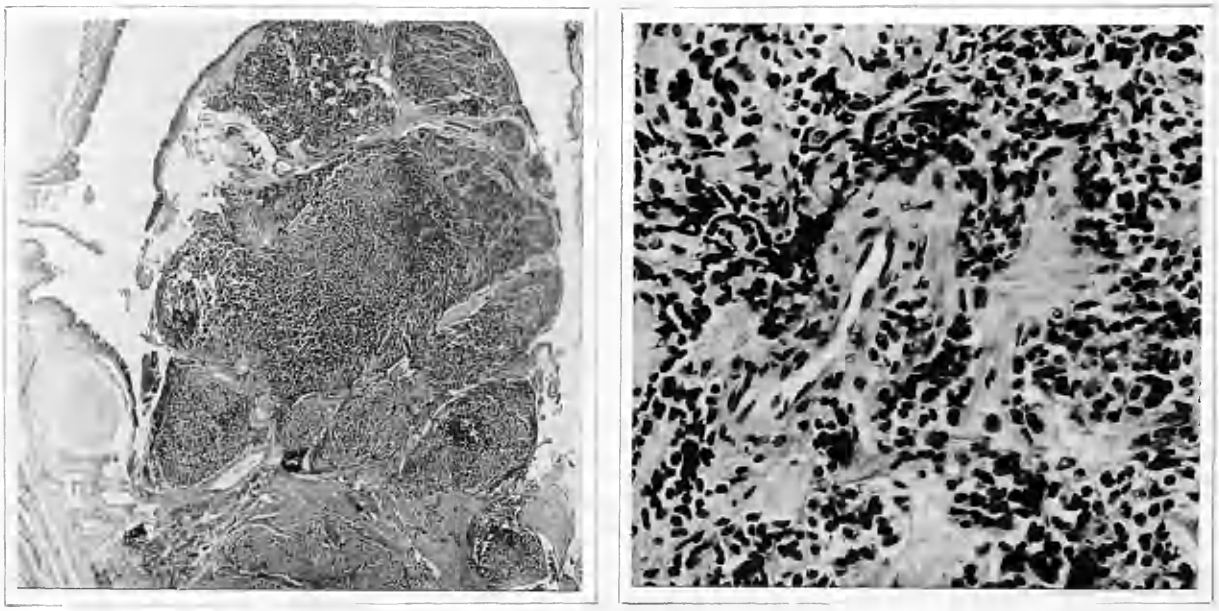


Fig. No.114. The photograph on the left is an enlarged picture of the "polyp" portion of the tumour. It is covered by bronchial epithelium. The photograph on the right shows the small oval cells with large nuclei. No mitotic figures are seen. This case was diagnosed as oat-cell carcinoma from the bronchoscopic biopsy tissue.

Case No. 39.

M.N. (51). Occupation - Housewife.

Admitted 29.12.48,

Dismissed 19. 2.49.

Diagnosis Adenoma of right lower lobe bronchus.

History. In December 1946 she had developed influenza with malaise, pyrexia and headaches. She felt she was recovering from these when she developed bronchitis accompanied by marked breath-:lessness on the slightest exertion , with severe cough and whitish sputum. She also had retrosternal discomfort. She had to return to bed where she remained for a further 5 weeks, when she made a complete recovery. Six months later she had a similar illness and was in bed for 6 weeks. Thereafter, these attacks recurred at 3 to 6 monthly intervals. The latest attack was 15 weeks prior to admission, when she had severe cough accompanied by whitish sputum and breathlessness and she required to go to bed. She developed pain in the right side of her chest and as her doctor thought she had pneumonia she was sent to Bridge of Earn Hospital where she was treated with sulphonamide and penicillin.

At this time she had one recurrence of blood stained sputum. A little fluid was aspirated from her chest and was found to be sterile. She had greatly improved, and on admission felt quite well and had no symptoms.

She was bronchoscoped at Bridge of Earn Hospital on 19.11.48 -"Smooth rounded tumour seen filling right lower lobe bronchus just below right upper lobe bronchus - pink in colour with a yellow spot on its upper aspect. Appearances suggest an adenoma".

Previous health. Cholecystectomy in 1944.

Examination. On examination, she was a fat woman, co-operative and intelligent. There was no cyanosis and no clubbing of the fingers.

Respiratory system. There was diminished respiratory excursion at the right base where the percussion note was impaired and the respiratory murmur was faintly heard, especially anteriorly, where the vocal resonance was also diminished. No crepitations were heard.

Genito-urinary system
Alimentary system
Cardio-vascular system } No abnormality.

Blood pressure 146/92.

She was bronchoscoped and the histological report was not conclusive but it was felt that the diagnosis was probably adenoma of bronchus accompanied by atypical inflammatory changes. It was not possible from the tissue obtained to completely exclude the possibility of it being entirely inflammatory.

The patient was re-bronchoscoped and histological report from the Victoria Infirmary 29/49, Dr. Davis. "Microscopic appearances are wholly consistent with those of the so-called bronchial adenoma. The tumour cells are small with rather dense structureless cytoplasm which is moderately eosinophilic. Their shape varies but where they are loosely arranged it it is similar to that of a plasma cell, and to add to this similarity the nuclei are often eccentric. The nuclear chromatin is, however, very dense and without pattern. There are some multi-nucleate cells, but mitoses are absent. There is no consistent arrangement of the cells. They occur in masses of varying size, separated by rather fine fibrous trabeculae. Within these masses there is a vague suggestion of alveolar formation but no true acini are evident and mucin secretion is quite absent. The dense fibrous tissue

at the periphery of the lesion contains scattered groups of tumour cells, so that in the present specimen at least the tumour is not sharply delimited. There is a moderate and variable subacute inflammatory infiltration and the overlying bronchial mucosa is thinned and is undergoing squamous metaplasia.

31.12.48. X-ray Report, Dr. Munro. "P.A. The view shows a triangular opacity at the right base, due to lobar atelectasis. There is also an effusion at the right base. The lateral views taken are of no diagnostic value.

The appearances are compatible with right lower lobe collapse due to bronchial occlusion".

21.1.49. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Cyclopropane.

The right chest was opened by the usual postero-lateral incision. The lower and middle lobes were collapsed and adherent to the chest wall and diaphragm. Both oblique and horizontal fissures were almost indefinable, due to inflammatory changes. The tumour could be felt within the bronchus and was extending up to the upper lobe bronchus.

Adhesions were divided and fissures were defined. The inferior pulmonary vein was ligated and divided. The bronchus was clamped and cut across immediately distal to the upper lobe bronchus. Thereafter the arteries of the lower and middle lobes were ligated and divided. The wound was closed.

23.1.49. Pathological Report, Mr. K. Fraser. "There is a dark red oval tumour about 2 cm. in length and 1 cm. in width completely obstructing the stem bronchus at the level of the middle lobe bronchus, both the middle and lower lobe bronchi are completely obstructed by the adenoma. The tumour appears to have quite a narrow pedicle of origin from the bronchial wall and no extrabronchial extension. The middle and lower lobes are collapsed and show signs of consolidation and commencing inflammatory changes".

24.1.49. X-ray Report, Dr. McKail. "There is some expansion of the remaining lung".

5.2.49. X-ray Report, Dr. McKail. "Most of the fluid has been removed from the right base. There is considerable elevation of the right dome of the diaphragm."

19.2.49. The wound was healed and she was discharged home.

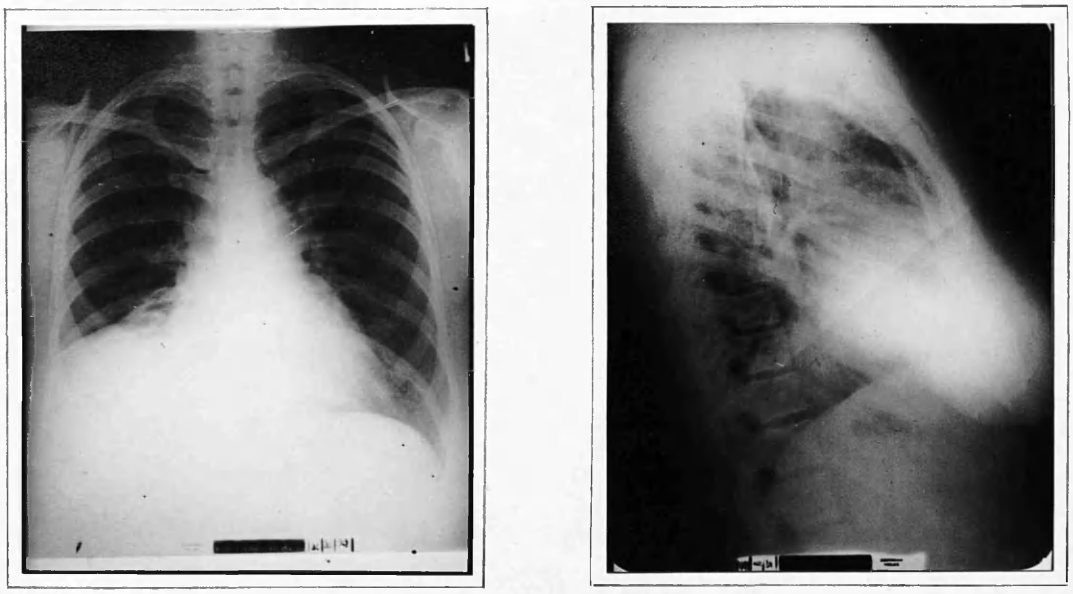


Fig. No. 115. Collapse and consolidation of right middle and lower lobes due to an adenoma in the stem bronchus.

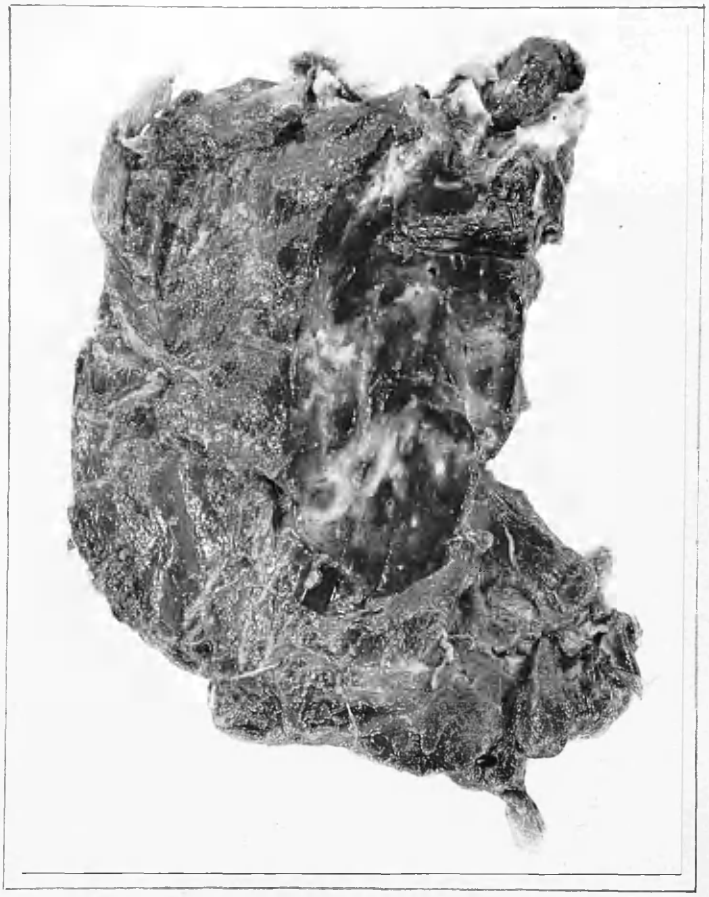


Fig. No. 116. The specimen consists of the right middle and lower lobes. At the right upper corner the adenoma can be seen protruding from the stem bronchus of the specimen. The adenoma has completely obstructed the bronchus. The lobes show consolidation and inflammatory changes.

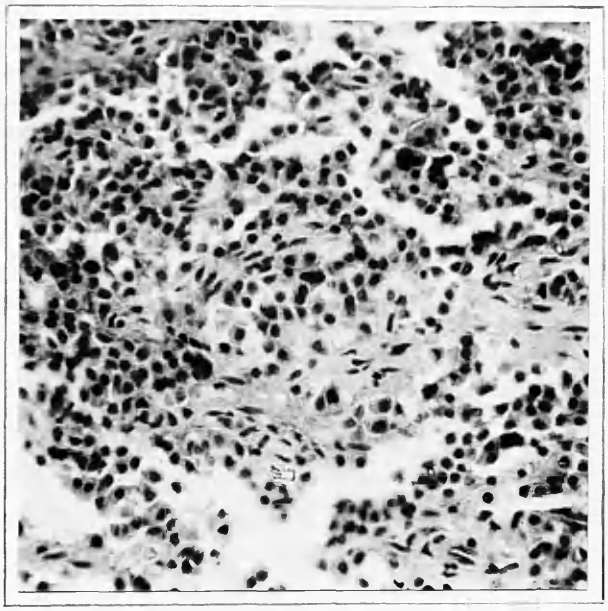


Fig. No.117. The cells are arranged in masses of varying size. There is no true formation of acini and no definite pattern. The cell nuclei are variable in size and shape; the nuclear chromatin is dense.

Case No. 40.

J.L. (49). Occupation - Housewife.

Admitted 20.3.44,

Dismissed 23.6.44.

Diagnosis Adenoma of right lower lobe bronchus.

History. For 26 years she had had periodic attacks of haemoptysis. When she was 23 years of age she experienced a gurgling sensation in her throat which resulted in a violent fit of coughing. This was followed by coughing up red frothy blood. Since that time the haemoptyses had occurred at approximately six monthly intervals. At the age of 40 she had had a bout of severe frequent bleeding and was confined to bed for three months. On 3rd March 1943 and 4th March 1943 she had three large haemoptyses which caused severe constitutional upset and after one of which she became unconscious.

Previous health. Generally good, apart from these illnesses. (X-ray at the Western Infirmary 1941 when a shadow was seen and diagnosed as a simple tumour requiring no treatment).

Family history. Relatives healthy. She had four healthy children.

Examination. She lay comfortably in bed; she was of good colour and there was no cyanosis, no enlarged glands, oedema, jaundice or clubbing of the fingers. Respiratory system. The chest was symmetrical and moved evenly on respiration. Percussion note was dull over the right lower lobe where the respiratory murmur was slightly diminished but was vesicular in type. Vocal fremitus and vocal resonance were normal. A few fine rales were heard at the right base.

Cardio-vascular system
Alimentary system
Central nervous system
Genito-urinary system
} No abnormality.

Blood pressure 135/78.

23.3.44. Bronchoscopic Examination, Dr. Howie. "The trachea is free from disease. The carina is central and slightly flattened with loss of knife edge. The right main bronchus is free to about 1½" below the lower lip of the middle lobe bronchus where a pill shaped area of neoplastic tissue is blocking the lower lobe bronchus. This is mobile, suggesting a pedunculated tumour. It bled easily to the touch when a portion was removed for biopsy. The picture is consistent with a large fibro-adenoma.

The middle and upper lobe bronchi showed no gross evidence of disease".

21.3.44. X-ray Report, Dr. McKail. "There is a rounded mass below the right hilum in close contact with the diaphragm and mediastinum. An area of atelectatic lung is seen lateral to it in the P.A. film, not definitely recognisable in the lateral film. The round mass is well defined and suggests a benign tumour, possibly an adenoma or angioma."

27.3.44. Lipiodol X-ray, Dr. McKail. "Several branches of the bronchus are seen to be adjacent to the tumour. The lower lobe in front of and behind the tumour is seen to be partly collapsed but not bronchiectatic.

14.4.44. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton - Pentothal, Cyclopropane.

The chest was opened by the usual right postero-lateral incision. A tumour was found in the lower lobe of the lung. It was about 2¼" in diameter and was just clear of the root of the lower lobe bronchus. The tumour and lower lobe were removed by "mass ligature lobectomy". As the chest was dry no drain was inserted and the chest

was closed after dusting with sulphonilamide powder.

16.4.44. Pathological Report, Mr. K. Fraser.

"This shows a greyish-white hard lobulated tumour 5.5 x 4.25 cms. in size. Below this area there is a spherical swelling 1.5 cm. in diameter of pale colour and of homogeneous appearance. The tumour has a false capsule of compressed lung tissue which strips readily off the tumour. Towards the centre there is an area of cartilage. The cut surface shows very definite lobulation with uneven bands of fibrous tissue and a few punctate haemorrhages.

Histological Report: Many sections show well formed but closed acini surrounded by varying areas of fibrous tissue. The cells are of well formed appearance and cubical in type. The neuclei are well stained; the cytoplasm is rather pale.

Dr. Davis of Victoria Infirmary kindly had a look at these sections. In one of the sections he found the tumour cells reaching up to a bronchus, the basal membrane of which was ruptured.

Dr. Davis of Victoria Infirmary and Dr. Lendrum of the Western Infirmary think that this is an adenoma

of long standing now undergoing invasive change".

19.4.44. The patient was very comfortable and the temperature was settling. Aspiration of the chest on the day following operation produced 600 ccs. and aspiration was repeated on every alternate day.

The lung was re-expanding.

23.6.44. The wound was healed and the patient was allowed home.

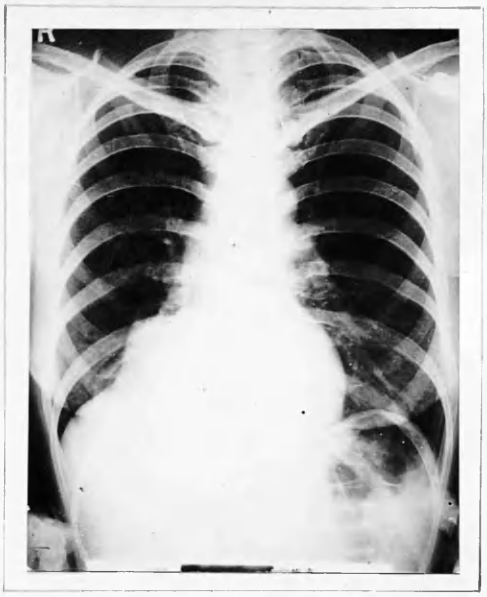
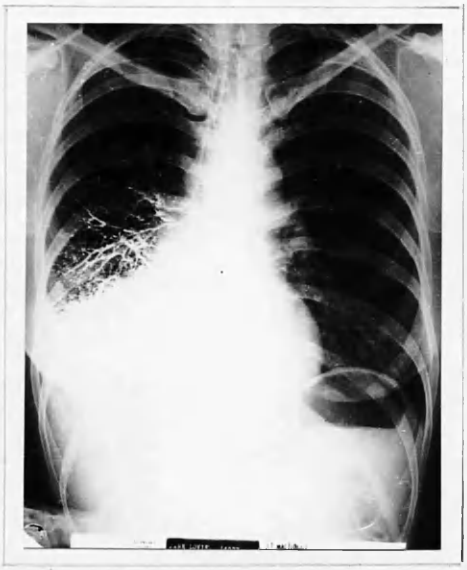


Fig. No. 118. A postero-anterior X-ray film showing the tumour shadow below the lung hilum and projecting lateral to the right border of the heart.



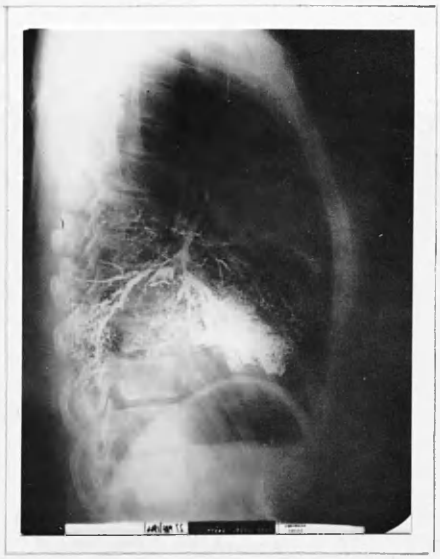


Fig. No. 119. Bronchograms. In the lateral X-ray film the lipiodol is "held up" in the lower lobe stem bronchus and only the apical segment bronchus of the lower lobe fills. The close proximity of the middle lobe bronchus anteriorly to the lower lobe apical bronchus is well seen.

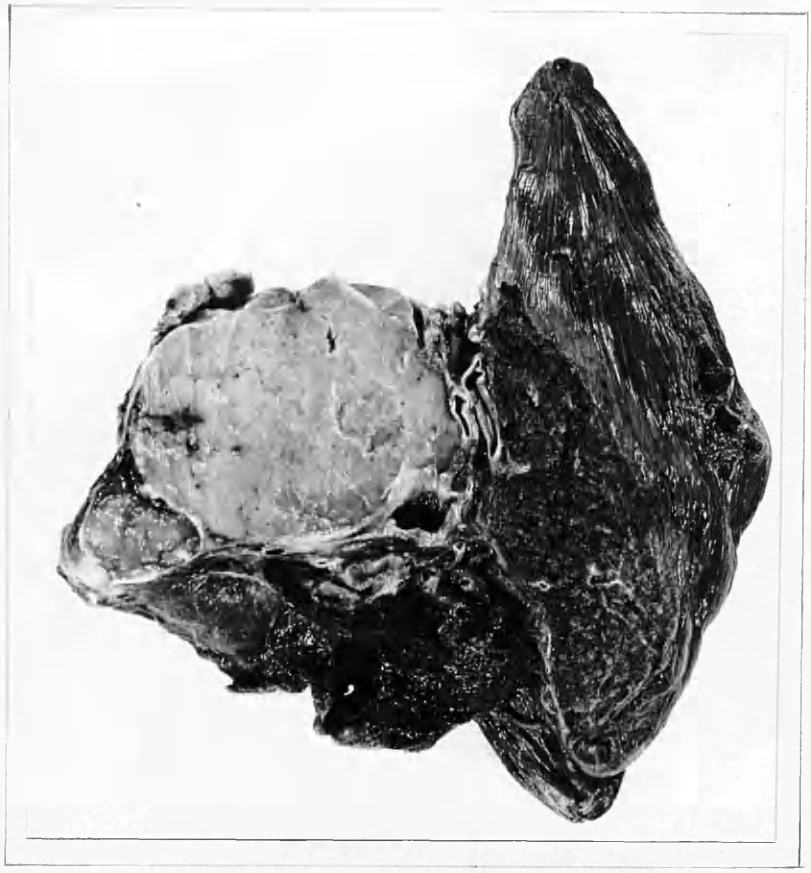


Fig. No. 120. The cut surface of the specimen. The adenoma was 5.5 x 4.25 cm. in size. The surrounding compressed lung tissue gives the appearance of a false capsule. Note the grape size congenital cyst immediately below and to the left of the tumour.

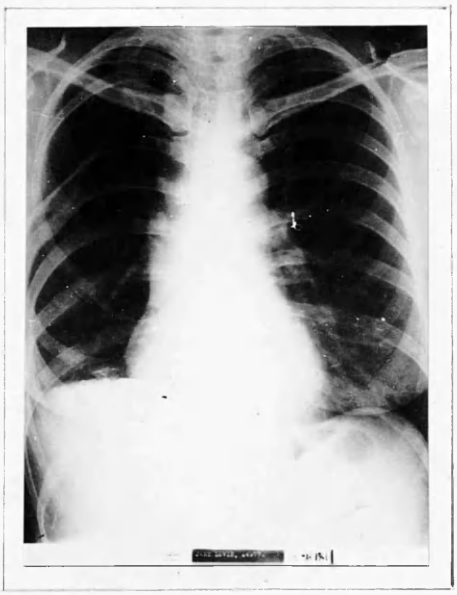


Fig. No.121. Post-operative X-ray film. The lung has completely re-expanded.

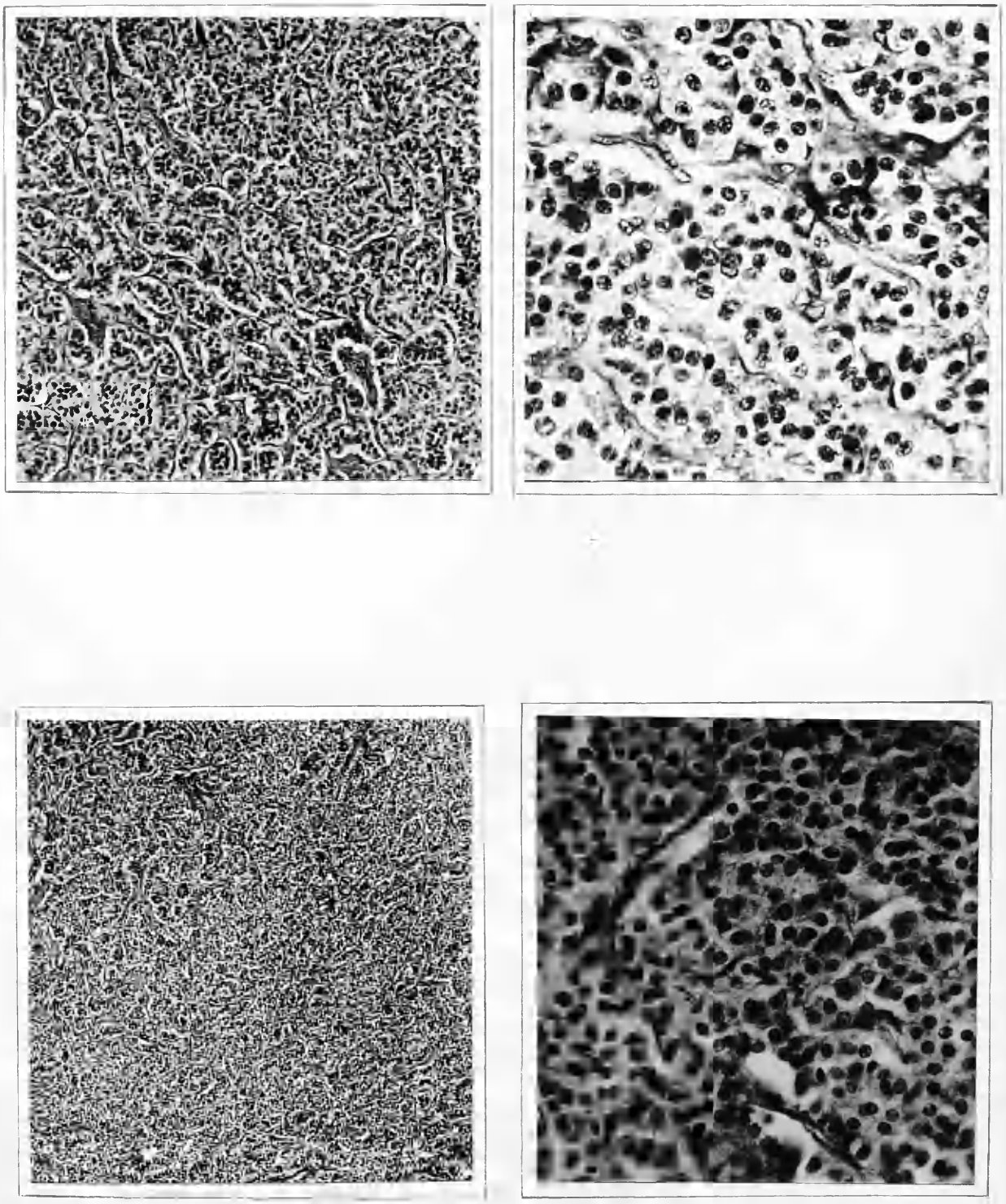


Fig. No. 122. Representative areas of the tumour showing well-formed closed acini surrounded by varying areas of fibrous tissue.

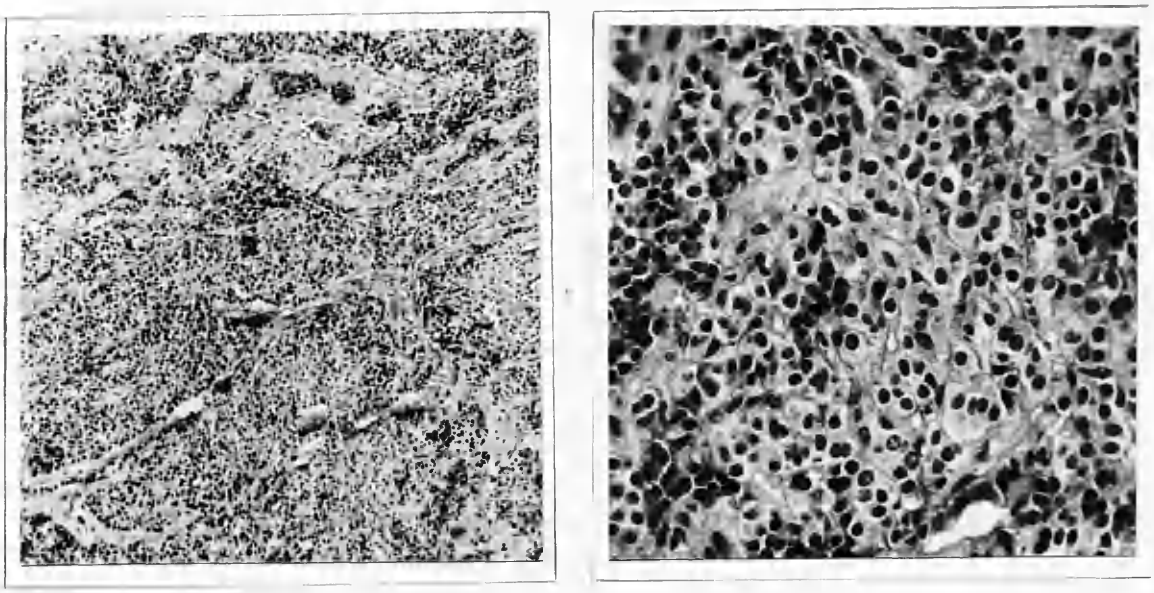


Fig. No. 123. Further areas of the same tumour.

Case No. 41.

M.B. (46).

Admitted 28.2.50,

Dismissed 23.4.50.

Diagnosis Adenoma of right middle lobe bronchus.

History. In 1939 she first became aware of a cough which had persisted until the time of admission. She coughed up several ounces of bright red blood in 1940 without any obvious cause. This bleeding persisted for 48 hours, when it ceased. She had had further haemoptyses at intervals of 3 or 4 months, until 2 years prior to admission, when she had no further haemoptyses. She frequently had complained of a feeling of tightness in the right chest when she had the bleedings. This tightness disappeared with the onset of menstrual flow. She had always had a cough and spit which persisted even in the absence of haemoptysis. For some time prior to admission she had had some feeling of discomfort in the right chest and breathlessness on exertion. There had been no loss of weight.

X-rays of her chest showed an opacity

in the right medial chest consistent with an adeonoma. This was first seen in 1940 and had shown no significant change. Bronchograms in 1946 failed to outline the right middle lobe. During the 10 years prior to admission she had been particularly susceptible to chest colds and she had had pleurisy in 1946.

Respiratory system. Movement of both sides of the chest was symmetrical and equal. There was some dullness over the right lung in the middle zone and some diminution of respiratory murmur. Otherwise the chest was normal.

1.3.50. Bronchoscopy, Dr. Semple. "Trachea, carina and stem bronchi normal, apart from wheeze with expiratory constriction. Growing from orifice of right middle lobe into stem bronchus is seen a pinkish tumour, probably an adenoma of the right middle lobe".

2.3.50. X-ray Report, Dr. McKail. "There is a well defined mass measuring 6 x 4 cms. at the right hilum. The mass is continuous with a layer of thickened pleura in the interlobar fissure. Pleural thickening is also seen on

the anterior chest wall. The appearances suggest a tumour. Carcinoma is probably more likely than an adenoma. Bronchoscopy is required".

3.3.50. Histological Report, Dr. Davis, Victoria Infirmary. "The microscopical appearances are those of a bronchial adenoma. Tumour cells are small with rounded nuclei. The chromatin is dense, without nucleoli and not a single mitosis was found. There is a fairly successful attempt at an alveolar or tubular arrangement of the tumour cells. Some of the cells show ill defined vacuolation but no mucin could be demonstrated by our routine method (Southgate's Mucicarmine) or by the periodic acid technique; the mucin is normal. Bronchial mucus glands which are present are brilliantly revealed by the lighter method, which also demonstrates unusually well the rich and delicate vascularity of the tumour. The tumour is covered by a squamous epithelium which is often vacuolated. Inflammatory changes are insignificant".

6.3.50. X-ray Report, Dr. McKail. "Right bronchogram - There is complete obstruction of the middle lobe bronchus without characteristic features".

10.3.50. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Cyclopropane,
Gas and Oxygen.

The right hemithorax was entered through the bed of the resected 6th rib. The pleural space was free and the only adhesions present were some between anterior portion of lower lobe and the chest wall and diaphragm.

Only the posterior half of the oblique fissure was patent. The fissure between lower and middle lobes could not be found. The middle lobe itself could not be identified and seemed to be replaced by solid tumour tissue. The tumour itself was larger than x-ray suggested and some difficulty was experienced in getting above it without encroaching on the upper lobe bronchus. The inferior pulmonary artery and vein and the vessels to the middle lobe were then isolated in turn, doubly transfixed, ligated and divided. The bronchus was cut across above the middle lobe bronchus and the lower and middle lobes were removed. The bronchus was closed with atraumatic silk sutures. Penicillin-sulphathiazole powder was applied to the bronchus stump and the wound was closed with drainage.

14.3.50. Drainage had only been slight during the previous 24 hours and an x-ray showed the upper lobe completely filling the hemithorax. The drainage tube was removed.

16.3.50. X-ray showed presence of fluid. She was aspirated in theatre and 250 ccs. of slightly blood stained fluid was withdrawn and thereafter air was withdrawn indefinitely - there must be a bronchial leak.

17.3.50. X-ray of the chest showed a small pneumothorax with moderate effusion.

3.4.50. The lung was well expanded.

23.4.50. She was allowed home.

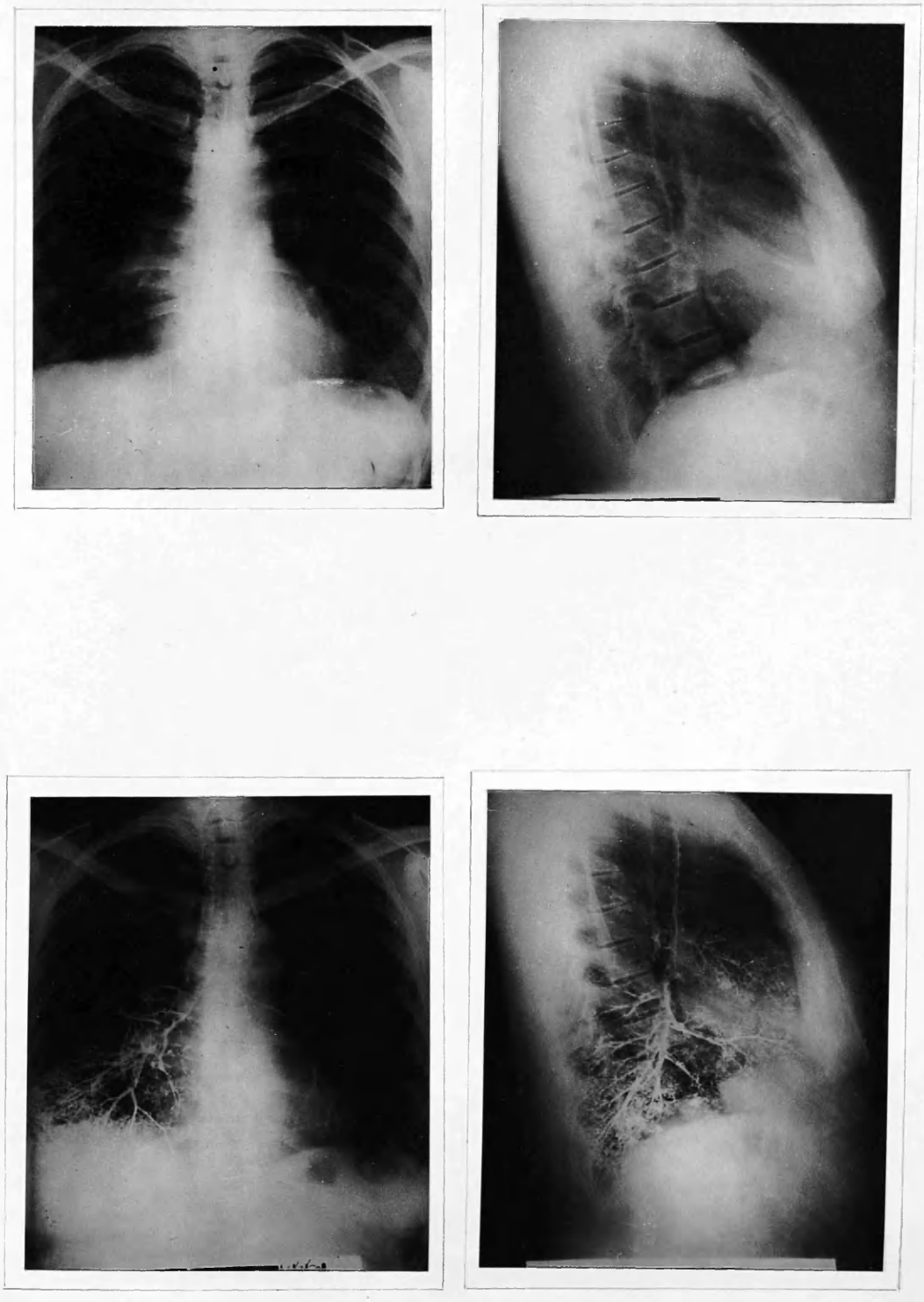
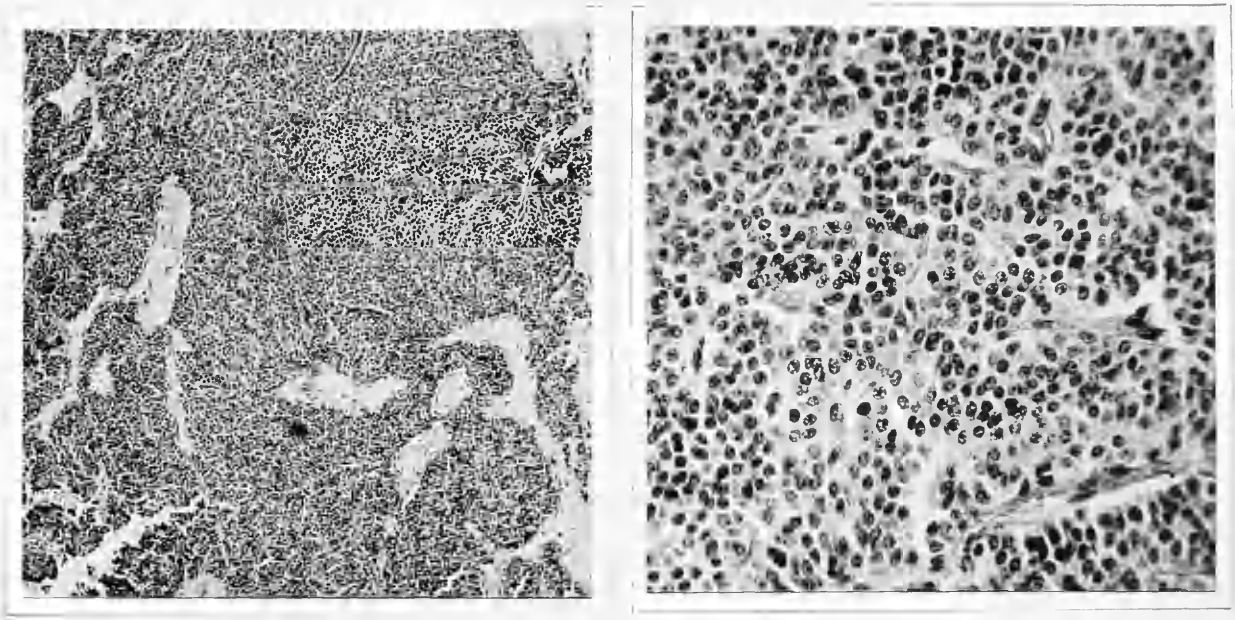


Fig.124. In the postero-anterior film there is a shadow at the right lung hilum; in the lateral view the tumour is seen just in front of the stem bronchus. It has caused collapse of the middle lobe. Lipiodol does not enter the middle lobe bronchus.

Fig. No. 125. The external aspect of the specimen. The bulk of the specimen is lower lobe. The stem bronchus has been opened to reveal the adenoma protruding from the orifice of the middle lobe bronchus. The mass projecting at 2 o'clock is the tumour and the remnants of the middle lobe.

Fig. No. 126. An enlarged photograph of the specimen to show the polypoidal tumour projection from the middle lobe bronchus. The cut surfaces of the stem bronchus have been widely separated to allow the photograph to be taken.

Fig. No. 127. The specimen has been cut across. The adenoma can be seen to almost completely replace the middle lobe. The cut surface of the lower lobe shows bronchiectasis with areas of consolidation and fibrosis.



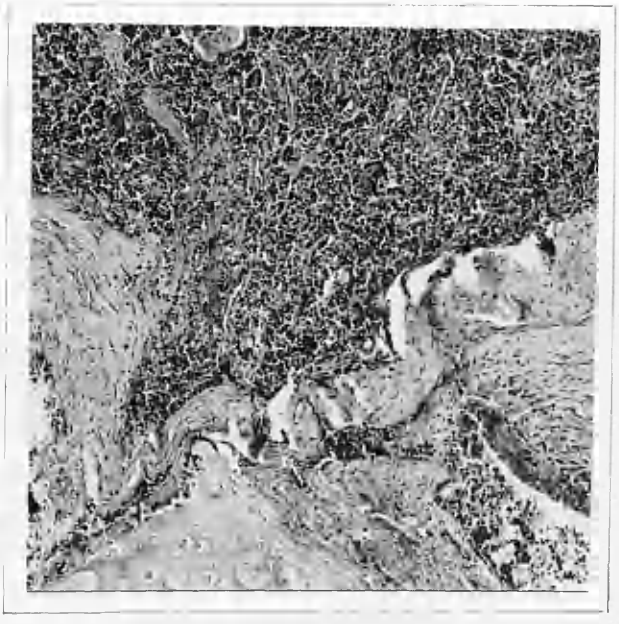


Fig.128. The top two photographs show typical regular arrangement of the small tumour cells in a fairly successful attempt at alveolar arrangement. The lower picture shows the tumour cells "reaching up" to bronchial cartilage.

Case No. 42.

C.H. (30).

Admitted 30.12.50,

Dismissed 4.5.51.

Diagnosis Bronchial adenoma.

History. In October 1945, the patient was in Strathclyde Hospital for six weeks with pneumonia on the left side. She was treated with sulphonilamide. In June 1947 she had a baby. In November 1947 a similar illness occurred and she was again treated in Strathclyde Hospital. Her main symptom at that time was breathlessness. There was no cough and no sputum. She remained well until March 1950, when she was again admitted to Stratyclyde with left anterior chest pain of sudden onset and breathlessness, also of sudden onset. On admission, she had a left pleural effusion, 24 ounces of clear fluid being withdrawn, which was sterile on culture. Her condition settled but in July the pyrexia recurred and further aspiration revealed pus which was also sterile and contained no tubercle bacilli. In October 1950, a male child was born and on return to Strathclyde hyper-resonance over the upper left lung

was found, fluid was aspirated and the pleural pressure was found to be + 2 - 9 at that time. An x-ray showed total collapse of the left lung. Subsequently, efforts to expand the left lung by withdrawal of air and physiotherapy, failed. On 17.12.50, she had a haemoptysis with an ounce of fresh blood but this had not been repeated.

At that time there was no cough nor sputum and the patient stated that she had only had a cough after being aspirated and the sputum had always been slight. She was gaining weight and her general condition was very good.

Previous history. Pneumonia as noted above in 1945 and 1947.

Examination. She was a fairly heavily built woman. There was no loss of weight, no anaemia and no oedema or cyanosis, nor was there finger clubbing. The left sterno-mastoid was more prominent than the right and the left hemithorax showed impaired expansion. Percussion note was hyper-resonant in the left infraclavicular fossa and axilla but elsewhere resonance on the left side was impaired especially at the base. Respiratory murmur - the sounds were

vesicular throughout, but very distant over the entire left side and inaudible over the left infraclavicular and left axillary regions. There were no accompaniments. Vocal fremitus and vocal resonance were diminished on the left side. Pulse rate was 92. Blood pressure 160/84. Otherwise, the other systems were normal.

5.1.51. X-ray Report, Dr. Donald. "Left pneumothorax with considerable degree of collapse of all the lobes of left lung and some effusion at the base.

After aspiration - some re-expansion of left lung but it is not yet sufficiently expanded to ascertain condition of the lung."

10.1.51. Bronchoscopy, Dr. Semple. "A round pinkish firm polypoid tumour obstructs the left stem bronchus above the level of the left upper lobe. Biopsy confirms bronchial adenoma".

Pathological Report, Victoria Infirmary, 77/51, Dr. Davis. "Microscopic examination confirms the clinical diagnosis of bronchial adenoma. The tumour shows the typical picture of areas of solid tubule formation together with others of acinar structure. The cells are of uniform medium sized type with vesicular nuclei, small dense nucleoli,

and showing no mitotic activity of any appreciable degree. Fibrous stroma is quite well formed and vascularity is moderate".

24.1.51. Bronchoscopy, Dr. Semple. "The adenoma was removed piecemeal and with the fourth bite a large polypus the size of a small bean came away. Moderate bleeding but apparently the lumen was clear after this".

27.1.51. There was slight blood stained sputum and definitely increased air entry in the left chest but x-ray showed little change.

7.2.51. A further bronchoscopy was done and further adenoma was seen, and further tissue removed, but the tumour could not be removed completely.

10.2.51. 3,000 c.cs of air were withdrawn and gave a reading of -6 over -12. There was no change in the underlying lung. A fourth attempt at bronchoscopy was carried out on 22.2.51, when it became obvious that it could not all be removed by this means.

2.3.51. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton - Pentothal, Tubarin, Gas & Oxygen and Pethedine.

A left pneumonectomy was carried out with

the patient in the face-down position and an intercostal bundle being preserved to seal over the bronchial stump. On opening the chest a large distension cyst of the upper lobe of the lung was found, the remaining portion of lung being collapsed. This cyst had given the appearance of the pneumothorax on the x-ray. The lung was removed, various hilar structures were secured, ligated and the bronchial stump was covered over with intercostal bundle which was stitched over the stump. A drainage tube was inserted and penicillin-sulphamethazine powder was instilled. The chest was closed.

Pathological Report, Mr. K. Fraser. "The adenoma projects as a cauliflower type of growth into the main bronchus which it appears to block completely. On the infra-medial aspect of the bronchus there is a white crisp oval swelling 1 x 1.5 cms. which is either pure adenoma, extrabronchial or invaded lymph gland. Immediately inferior to this there are two lymph glands showing greyish white areas. On the postero-superior aspect there is an enormous cyst, 12 x 10 cms., with a glistening shiny pale blue surface. There are at least three bronchial communications from what would appear to be the bronchus to the upper lobe of the left lung.

Histological examination of the white tumour like tissue below the bronchus showed it to be a portion of the adenoma. The lymph glands showed no invasion".

5.3.51. Histological Report, Royal College of Physicians, Dr. Lees. "Lymph nodes. All the lymph nodes show a picture of sarcoidosis and this can be taken as a residue of tuberculosis. Scattered throughout the lymphoid tissue are numerous circumscribed foci of large pale endothelial cells with some multinucleated giant cells. Giant cells have necrotic centre, no caseation. No evidence of any adenosis or neoplasm. Little doubt she has low grade tuberculous infection".

4.4.51. Chest aspirated - pus withdrawn. De pezzer catheter inserted. Drainage of pus continued. Pus contained B.coli.

4.5.51. Chest now nearly empty. Wound closed. Allowed home.

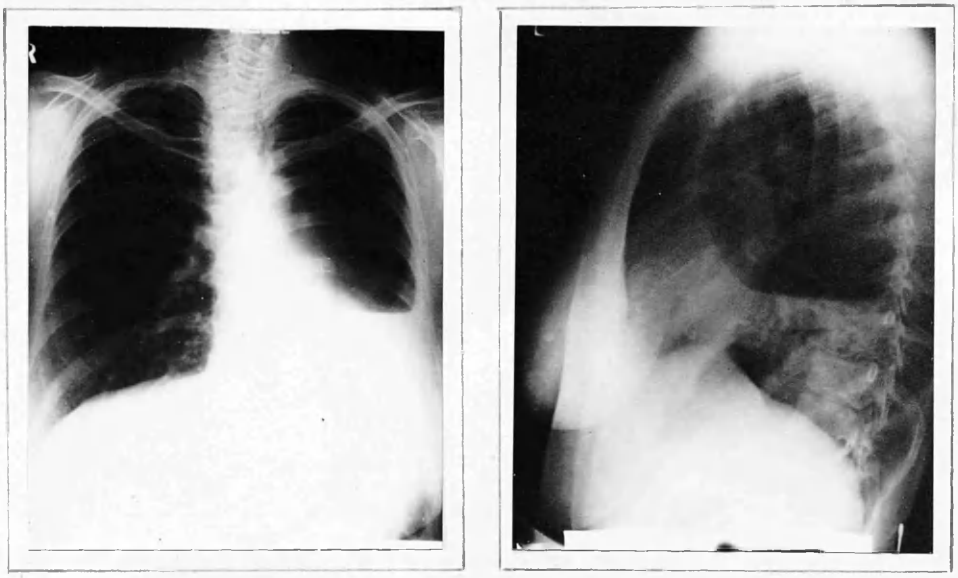


Fig. No. 129. The postero-anterior X-ray film shows collapse of the left lung and what appears to be a pneumothorax; the lateral view, however, clearly outlines a tension air cyst above the collapsed lung.

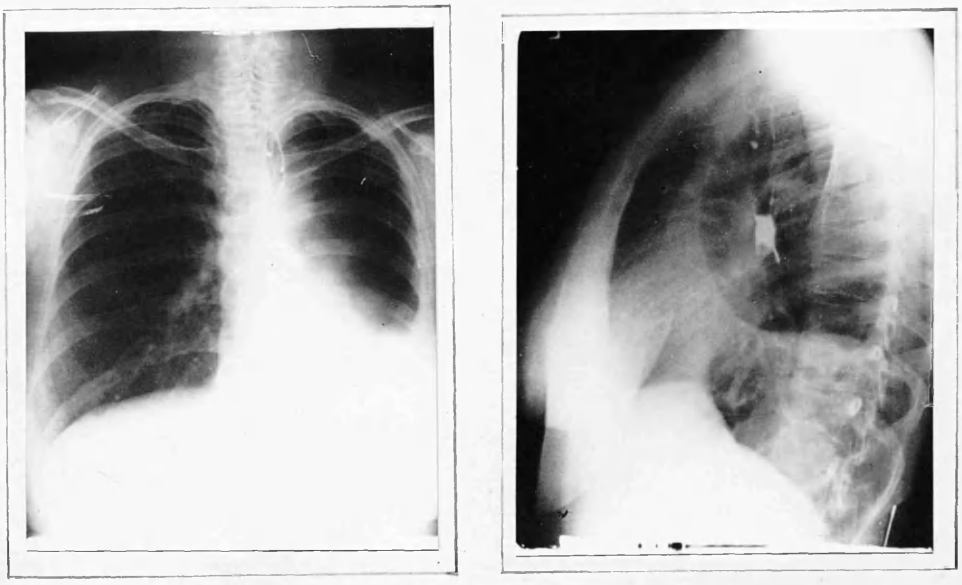


Fig. No. 130. Bronchogram. The lateral view shows complete blockage of the left stem bronchus. There is upward indentation of the lipiodol by the tumour.

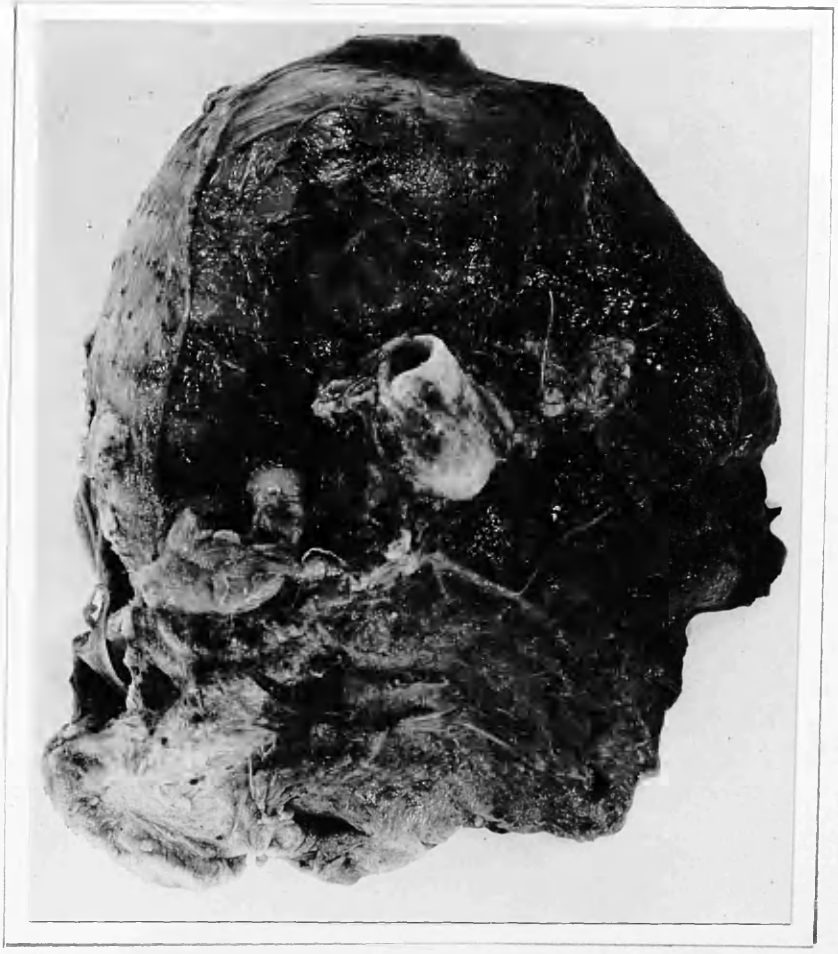


Fig. No. 131. The external aspect of the specimen. The huge tension cyst surmounts the collapsed lung.

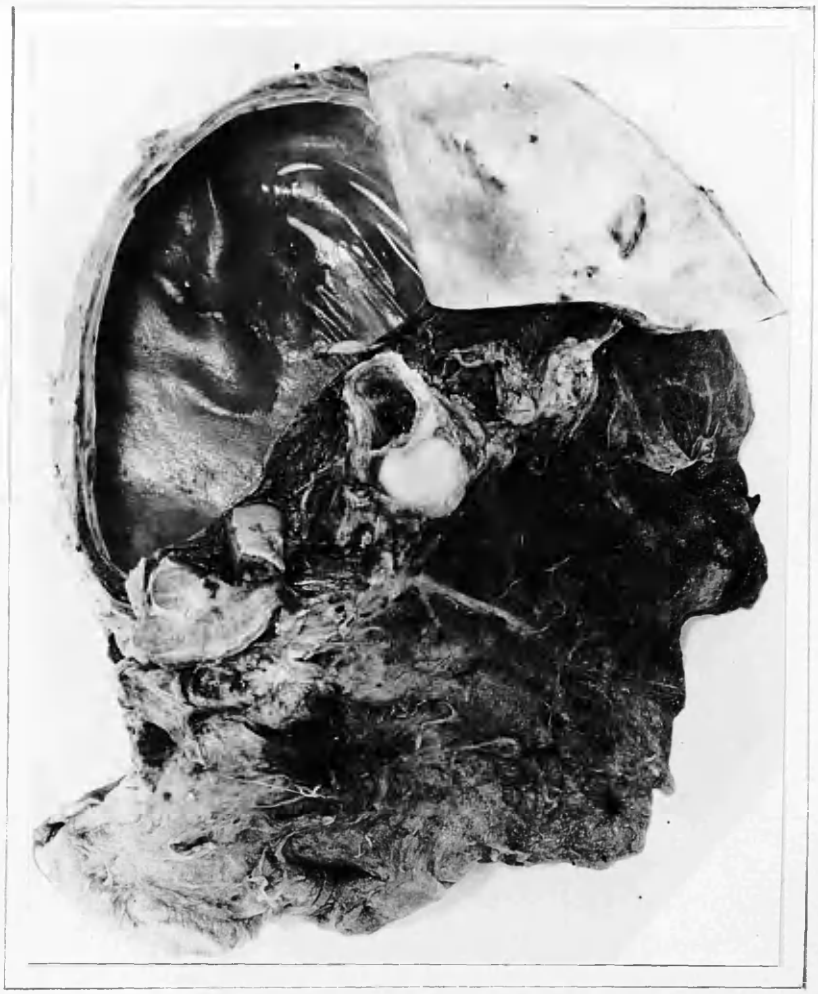


Fig. No. 132. A flap of the cyst wall has been turned back. The stem bronchus has been cut open to reveal the dark surface of the adenoma projecting into the lumen of the bronchus. The airway was completely blocked by the tumour. The white area below the bronchus is the cut surface of the extrabronchial portion of the adenoma.

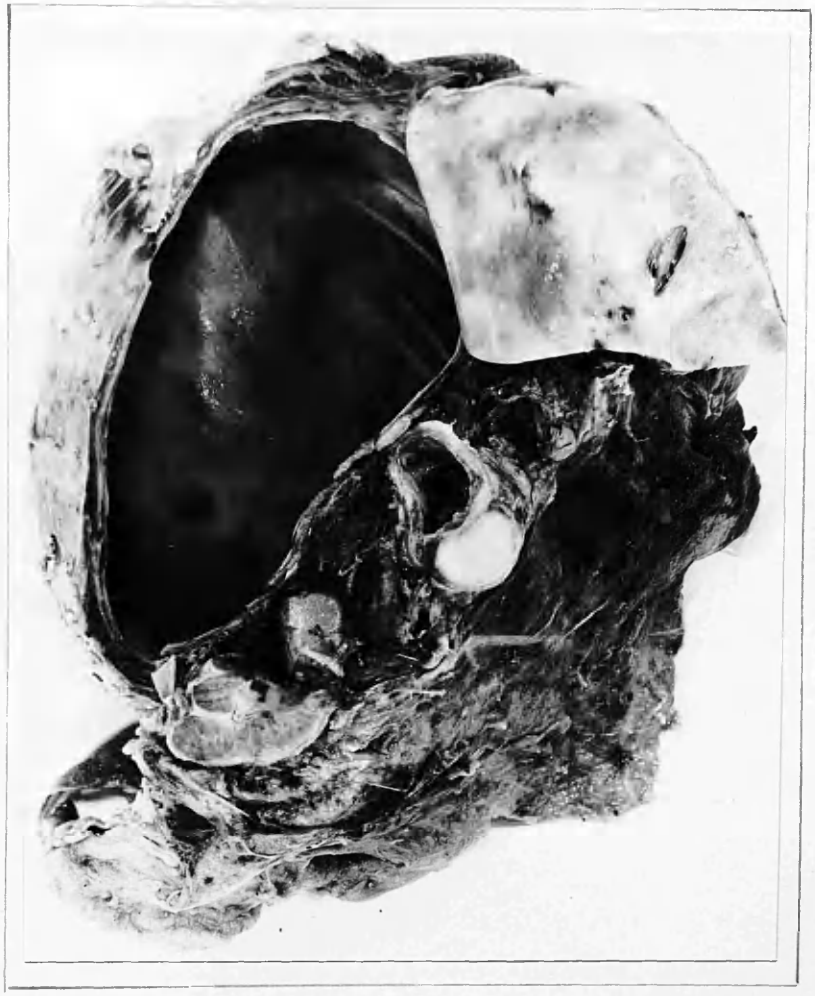
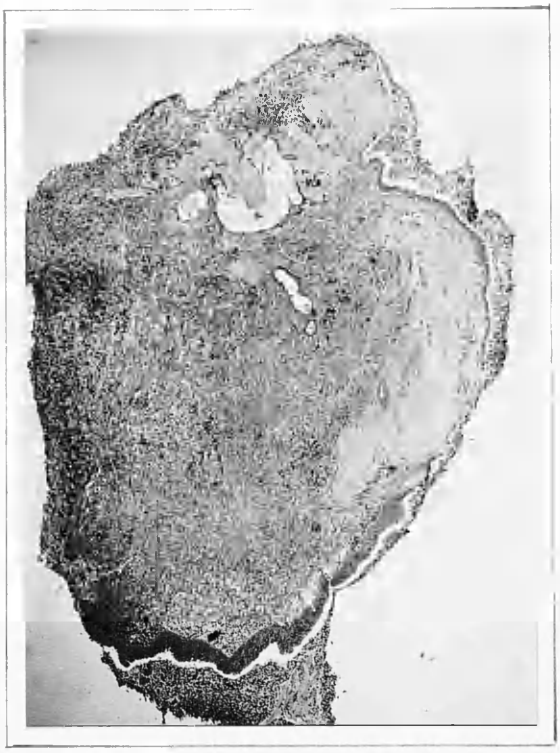


Fig. No.133. Another view of the specimen to reveal two of the bronchial communications. These can be seen within the cyst in line with the adenoma.



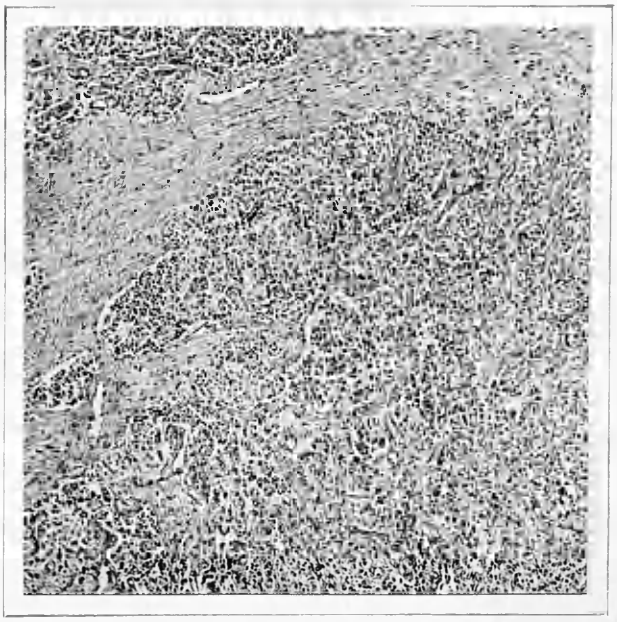


Fig. No. 134. The photograph on the left is a magnified view of part of the tumour. In places it is lined by bronchial epithelium. The photograph on the right is representative of the histological appearances. There is a fair degree of lobulation and considerable fibrous tissue.

Case No.43.

R.M. (45). Occupation - Book-keeper.

Admitted 12.4.47, 25.8.47,

Dismissed 8.6.47. 9.10.47.

Diagnosis Bronchial adenoma of right lung.

History. In September 1946 she coughed up fresh blood, which amounted to several teaspoonfuls in quantity. Her general condition had been good. There had been little cough or other symptoms present. On three further occasions she had had small bleedings following which she had been in bed but had felt well.

Previous health. Her breast was removed 14 years ago for chronic mastitis and she had had pleurisy four years ago.

Clinical Examination. X-ray and clinical examination suggested a collapse of the right lower lobe.

16.4.47. Bronchoscopy, Dr. Semple. "Trachea, carina and left bronchus normal. At distal end of right main bronchus there is seen a red fleshy mass; feels firm and hard". Biopsy specimen showed only cartilage, mucous gland and chronic inflammatory cell reaction.

17.4.47. Air entry in the right lower lobe now more extensive.

19.4.47. Histological Report, Dr. Park, Royal College of Physicians, No.4120/2315.

1. No evidence of malignancy, nor of adenoma.

2. A small flake of cartilage with numerous glands adjacent.

3. Chronic inflammatory cell reaction.

4. No evidence of T.B.

29.4.47. X-ray Report, Dr. McKail. "There is a small rounded area of opacity superimposed on the shadow of the posterior end of the 9th right rib and extending slightly above and below it. On screen examination it appears to lie at about the same depth as the pulmonary vessel shadow which is seen slightly to the right. Appearances could possibly be due to a simple tumour".

5.5.47. Bronchogram, Dr. McKail. "The bronchial walls appear within normal limits, but there appears to be some generalised downward displacement, the branch to the middle lobe either not filling or being superimposed on those of the lower lobe.

Appearances suggest that this is produced by some collapse".

28.5.47. Bronchoscopy, Dr. Semple. "As before;

red, firm tumour present in right lower lobe bronchus".

Biopsy - Now shows picture suggesting bronchial adenoma.

6.6.47. X-ray Report, Dr. McKail. "Adenoma of the right lower lobe bronchus. Compared with film of 29.4.47 some expansion of the lower lobe of the right lung has occurred, following removal of part of the tumour by endoscopy".

8.6.47. Returned home.

25.8.47. Re-admitted. On leaving hospital she was quite well and remained well until 13.8.47 when she had a further haemoptysis of about half a cup of bright red blood. She was admitted to Raigmore Hospital on 16.8.47. The following day she had a further slight bleeding. Examination showed that she was rather pale and tired. There was some dullness and weakened breath sounds at the right base.

28.8.47. X-ray Report, Dr. McKail. "Compared with film of 6.6.47 there is increased opacity of the basal segments of the right lower lobe. This may be due to haemorrhage from the adenoma. There is no increase in the amount of atelectasis".

2.9.47. Haemoglobin 62%. R.B.C. 3 million.
B.S.R. 3 mm. after one hour.
No further haemoptyses. Very small epistaxis twice during the past three days. General condition improving.

9.9.47. Operation - Mr. Dick, Mr. Fraser.
Dr. Pinkerton,
Pentothal,
Cyclopropane.

The chest was opened through the 6th right interspace. The 6th rib was cut at its posterior end. The lung was found to be free. The right lower lobe was removed and the tumour cut away completely with the lobe. The remaining portion of the lung was encouraged to re-expand with the aid of a leak tube while the wound was being closed. De pezzer catheter was inserted through a separate stab wound. Penicillin instilled into the wound. One pint of blood and 3½ pints of saline were given in the evening and night following operation.

10.9.47. X-ray Report, Dr. McKail. "Remainder of the right lung is almost completely expanded".

12.9.47. General condition good. Breath sounds were very good and very well heard on both sides of the chest.

25.9.47. Still well. Wound healed.

X-ray showed the lobe to be well out.

Allowed up.

26.9.47. Walking about.

9.10.47. Went home to-day. Well.

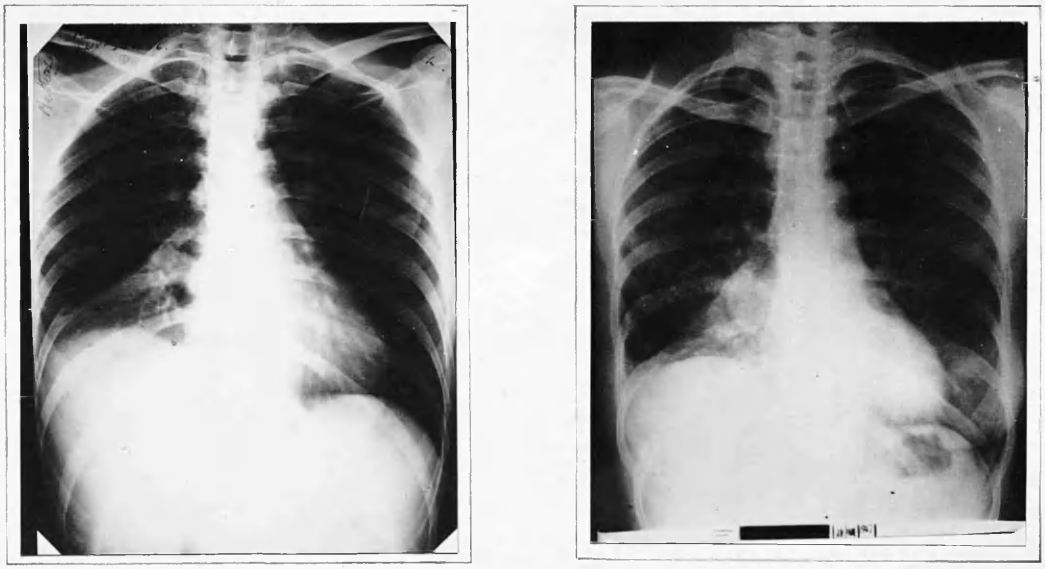


Fig. No. 135. A roughly oval shadow is seen projecting to the right of the right border of the heart. Partial collapse of the lower lobe is evidenced by the triangular shadow seen in the right lower hemithorax and by the elevation of the right diaphragm. The X-ray film on the right was taken after bronchoscopic biopsy; in spite of being of less penetration it does show improved aeration of the lower lobe.

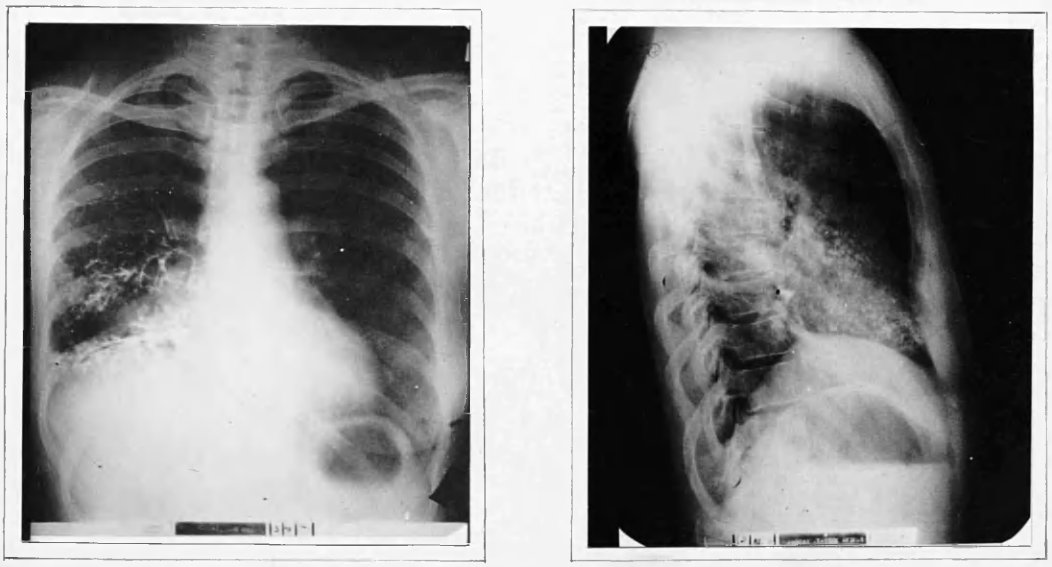
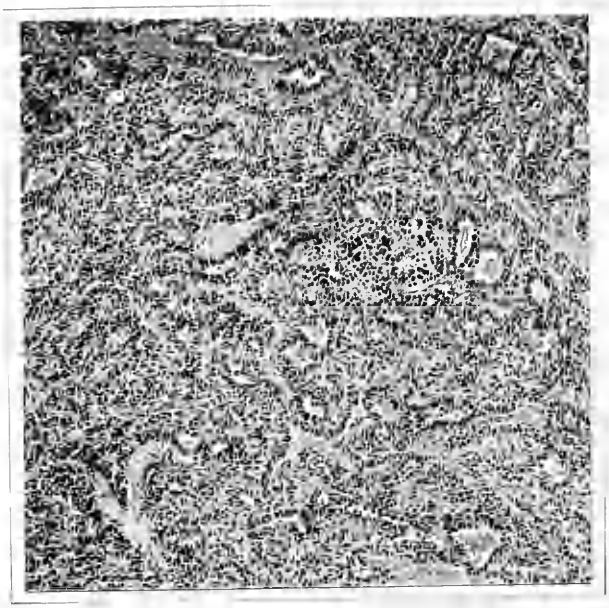
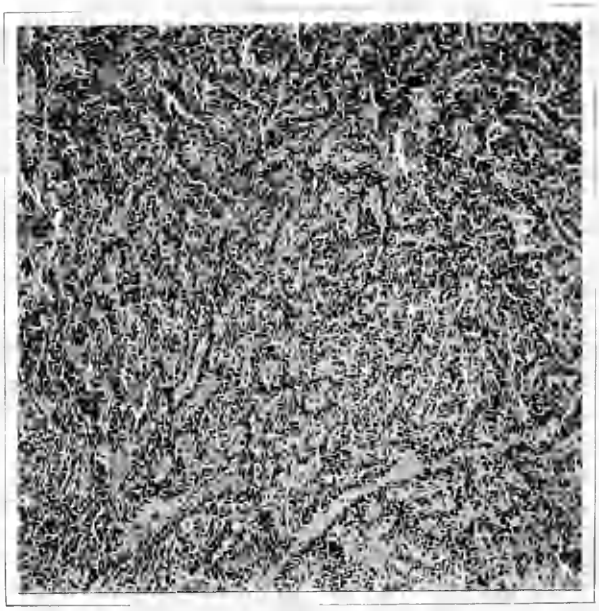


Fig. No. 136. Shows failure of the lipiodol to enter the posterior and middle branches of the lower lobe.

Fig. No. 137. The tumour is almost entirely extrabronchial; immediately below the tumour the bronchiectatic changes in the middle and posterior bronchi are seen; the bronchi are choked by inspissated muco-pus; immediately to the right of these bronchi the anterior segment bronchus is seen open and apparently normal.





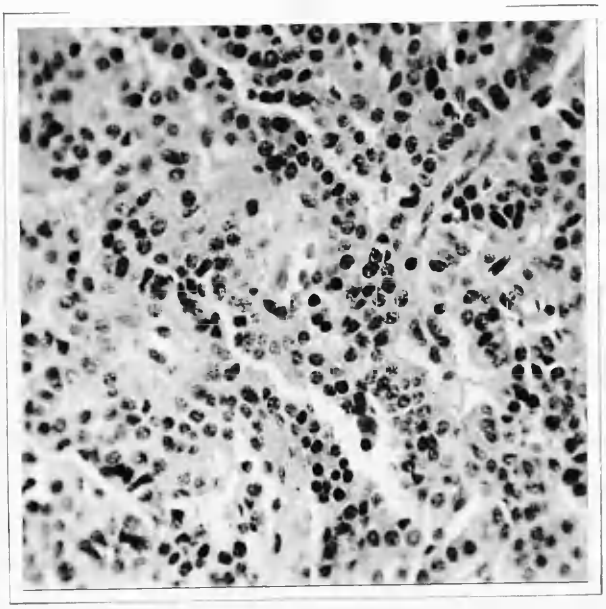


Fig. No. 138. The histological appearances. Uniformity and regularity of cell are well seen.

Case No.44.

A.H. (39). Occupation - Motor Driver.

Admitted 14.3.50,

Dismissed 21.4.50.

Diagnosis Adenoma of right lower lobe bronchus.

History. On 20th January, he developed pains in his lower limbs and went to bed, believing he had an attack of influenza. Three days later he developed a large haemoptysis and coughed up about a pint of blood. He was x-rayed on 27th January at Irvine Central Hospital and some abnormality was seen in the right lower lobe. He had felt quite well since his haemoptysis. He was bronchoscoped at Irvine on 14th February, and a biopsy revealed an oat-cell carcinoma. He had been regularly at work until 20th January and had felt quite fit for a heavy job. He had not had blood staining of his spit and he had no appreciable cough. His weight had been steady.

Previous health. In 1941 he had pleurisy in his right chest and was off work for five months. A final diagnosis of unresolved pneumonia was made. His recovery was uninterrupted and there was no appreciable remaining dyspnoea. He had a further upset 2 years

prior to admission when he was off work for five weeks with a further condition of his chest. He had been more subject to chest colds than usual. He had pneumonia in infancy and his mother was under the impression that he had only one lung.

Examination. He was a well nourished, fresh complexioned man of good physique. There was no evidence of loss of weight. There were no palpably enlarged glands and no distended veins.

Respiratory system. The percussion note was resonant throughout the chest. Medium rales were heard in the right axilla and in the posterior basal region. Respiratory murmur was broncho-vesicular. The vocal resonance was well transmitted. The left lung was normal.

Alimentary system,
Central nervous system) No abnormality.
Genito-urinary system

14.3.50. X-ray Report, Dr. McKail. "There is partial atelectasis of the lower lobe of the right lung with associated inflammatory changes. The right costo-phrenic angle is obliterated by pleural thickening. The right hilum appears enlarged. The appearances are possibly due to bronchial carcinoma. Bronchoscopy is required".

15.3.50. Bronchoscopy, Dr. Semple. "Trachea, carina and stem bronchi normal. There is a large reddish tumour in the right lower lobe bronchus extending up to the orifice of the right middle lobe. A large polypoid mass was removed in one piece by forceps. There was much bleeding and release of secretion, but right lower lobe seen patent after this.

Conclusion - ? Adenoma.

Histology - Bronchial Adenoma".

16.3.50. Pathological Report, Victoria Infirmary, No. 645/50, Dr. Davis. "The microscopical appearances are those of an unusually good example of a bronchial adenoma. Two varieties of cell and of arrangement were present, although the one is not wholly distinct from the other. The first pattern is made up of small round or ovoid cells having dense nuclear chromatin and forming short and anastomosing cords, often with ill-defined alveoli. The second variety of cell is larger. The nucleus is elongated and the chromatin is less dense and is finely divided. The cells are arranged in large rounded masses (solid alveoli) with fairly constant palisading of the peripheral cells. The cell masses

are separated by narrow fibrous septa which form a closely woven network. No mitoses were found in any of the tumour cells. The tumour is partially covered by a respiratory type of epithelium which is becoming modified towards an epidermoid type. In the sub-epithelial zone there is a moderate infiltration of plasma cells, eosinophils and lymphocytes. Mucin production by the tumour cells is absent. The tumour is nourished by innumerable delicate blood capillaries with occasional equally thin walled vessels of much greater calibre. Bronchial biopsy.
Diagnosis - Bronchial Adenoma".

In this case we have, then, a condition which has been diagnosed histologically as a carcinoma by a reputable pathologist, but further tissue removed at further bronchoscopy was found to be an adenoma. With this in view, operation was decided upon.

24.3.50. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Cyclopropane,
Gas & Oxygen.

The right chest was opened through the bed of the 7th rib. The lower and middle lobes were densely adherent to the chest wall, diaphragm and mediastinum,

and there was great difficulty in separating these lobes from the chest wall and diaphragm. The hilum of the lower lobe was still bulky after freeing adhesions and opening up the fissure, and identification of individual structures was impossible. A series of catgut sutures and silk sutures were inserted round the hilum and the lower lobe was cut away. A series of ligatures were then tied over the remnant of the hilar stump and a few additional sutures were inserted. A de pezzer catheter was brought out through the posterior intercostal space as a drainage tube, and the chest was closed.

Following the operation, the lobe was opened up and it was found that the lobectomy had been performed distal to the site of the tumour which, in all probability, had been entirely removed at the time of bronchoscopy.

3.4.50. Sputum blood stained.

7.4.50. General condition fairly good.

21.4.50. Well. Allowed home.

14.7.50. Reported well. Advised to start work.

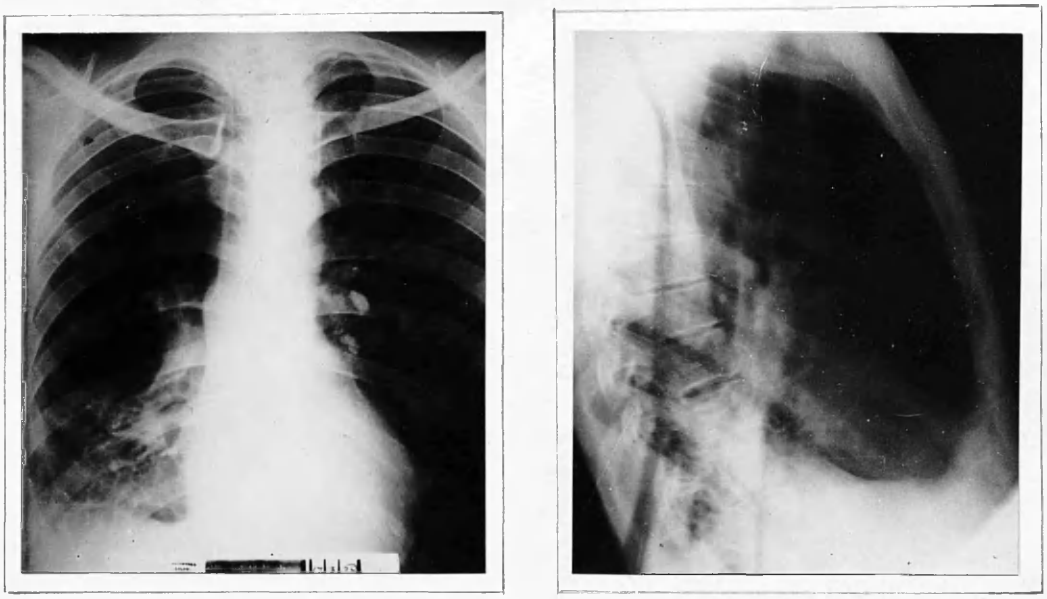


Fig. No. 139. Atelectasis and consolidation of the right lower lobe the result of obstruction caused by an adenoma blocking the lower lobe bronchus.

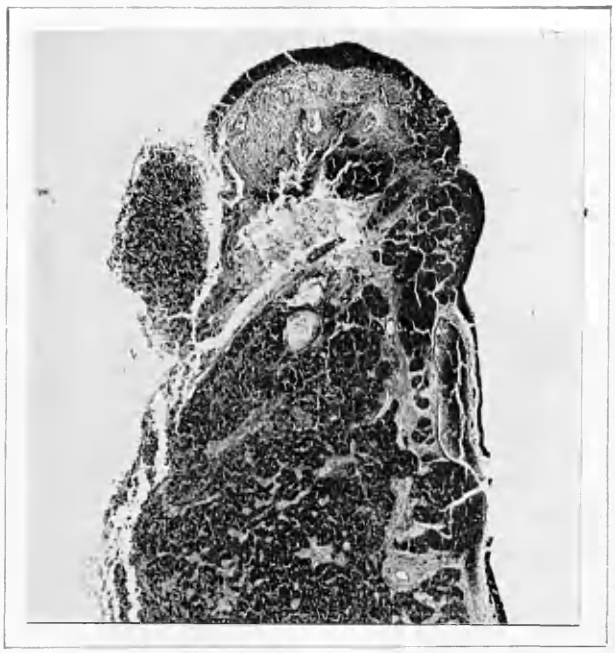
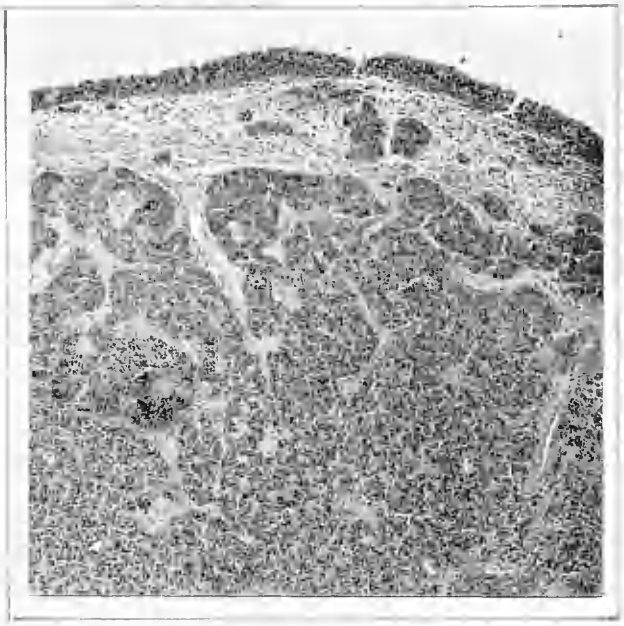
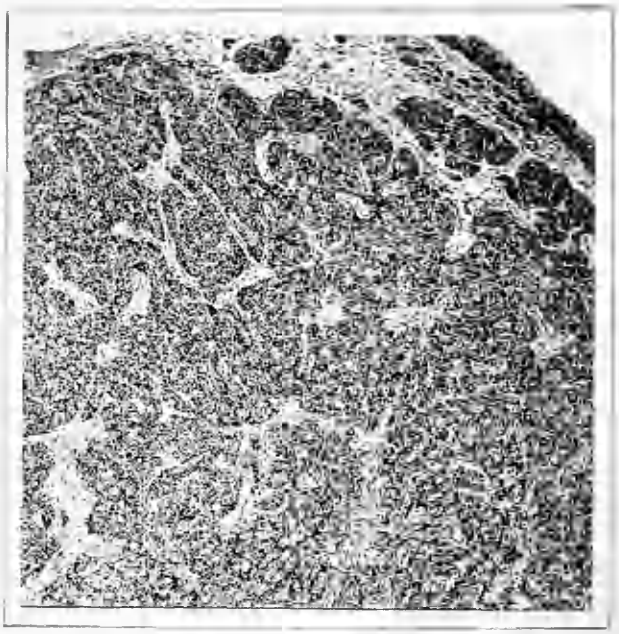
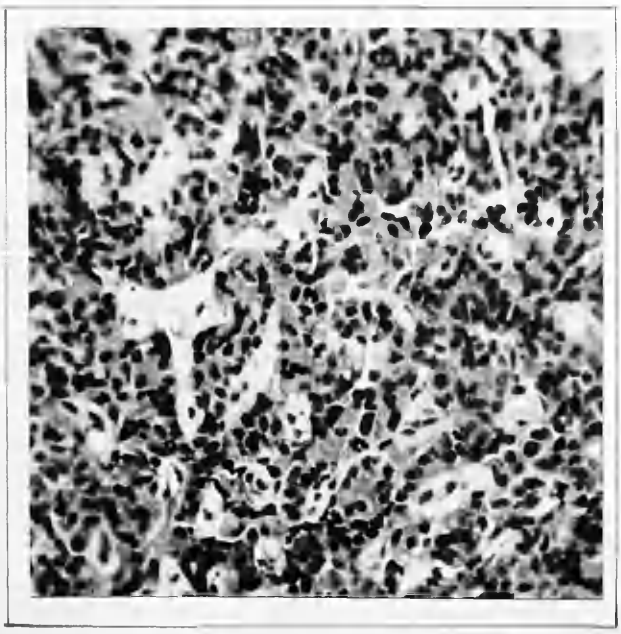


Fig. No. 140. An enlarged photograph of the tumour removed through the bronchoscope. There is an incomplete lining of bronchial epithelium.







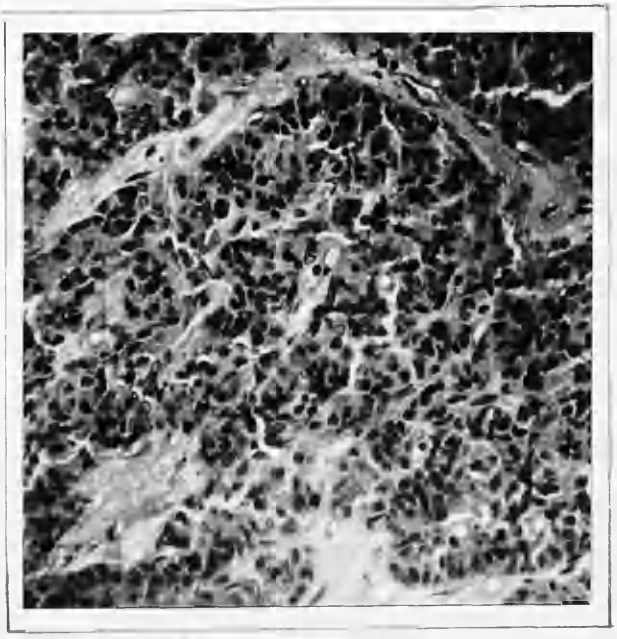


Fig. No. 141. In some areas the cells are arranged in communicating sheets and columns, in others they are in large rounded masses - solid alveoli.

Case No. 45.

J.S. (42). Occupation - Domestic Servant.

Admitted 24.7.44,

Dismissed 2.11.44.

Diagnosis Adenoma of right bronchus.

History. Since the age of 22 she had been troubled with breathlessness. Fourteen years later she developed a cough of intermittent type, which was of a ticklish variety. She noticed no change in in her voice. On 3.6.42, two years prior to admission, she went into Inverurie Hospital with "pneumonia". She was discharged four weeks later with impaired resonance at her right base and she was re-admitted in June 1944 with a diagnosis of pneumonia. A needle was put into the chest and 5 ccs. of straw coloured fluid were removed and were found to be sterile.

Blood examination. She appeared to have a secondary anaemia, with B.S.R. of 55.

Family history. Father died of ulcers: mother died of cancer.

Examination. She appeared to be a rather timid patient, with somewhat prominent eyes; there was

no enlargement of lymph glands.

Respiratory system. There was no expansion at the right base posteriorly and this side appeared to droop. Respiratory murmur was very faint and vesicular at the right base, where the percussion note was dull and vocal resonance was absent. A few fine crepitations were heard at the right base.

Cardio-vascular system)
Central nervous system) No abnormality.

30.6.44. X-ray Report, Aberdeen Royal Infirmary. "An obstruction of the right stem bronchus about ½" below the eparterial bronchus and above the middle lobe bronchus was seen. The obstruction was not quite complete, and traces of the lipiodol leaked through into the lung field. The obstruction is an intrabronchial one and surrounds the wall of the bronchus completely, suggesting more a malignant tumour than a benign one.

The upper lobe was fairly well filled and was normal".

3.7.44. Bronchoscopic biopsy report, Dr. Davidson, Aberdeen Royal Infirmary. "The specimen contains a growth of oat-celled carcinoma".

29.7.44. X-ray Report, Dr. McKail. "There was atelectasis of the right lower lobe and bronchoscopy is advised".

15.8.44. Operation - Mr. Dick, Mr. Fraser.

Dr. Easson -
Pentothal,
Cyclopropane.

The right chest was opened by a right postero-lateral incision. The pleura was incised around the hilum of the lung and the hilar structures were taken in the following order.

First the pulmonary artery, then the bronchus, followed by the pulmonary veins.

When the second pulmonary vein was divided she suddenly collapsed but responded well to coramine and other measures. Penicillin was run into the chest and the wound was closed.

16.8.44. She was well and had had a good night.

18.8.44. Progress was satisfactory.

2.11.44. After operation she had several aspirations of the right chest, at first blood stained and finally serous fluid was obtained. All of these were sterile. Following operation she was very well but had a slight pyrexia for two or three weeks.

She was discharged home.

Histological Report, Dr. Taylor. "Mixed squamous and oat-cell carcinoma, the former predominating.

Note.

This patient was reported as well, having been seen in Perth Royal Infirmary in November 1947.

A review of the histological sections seems to indicate that the tumour has been an adenoma, and not a carcinoma.

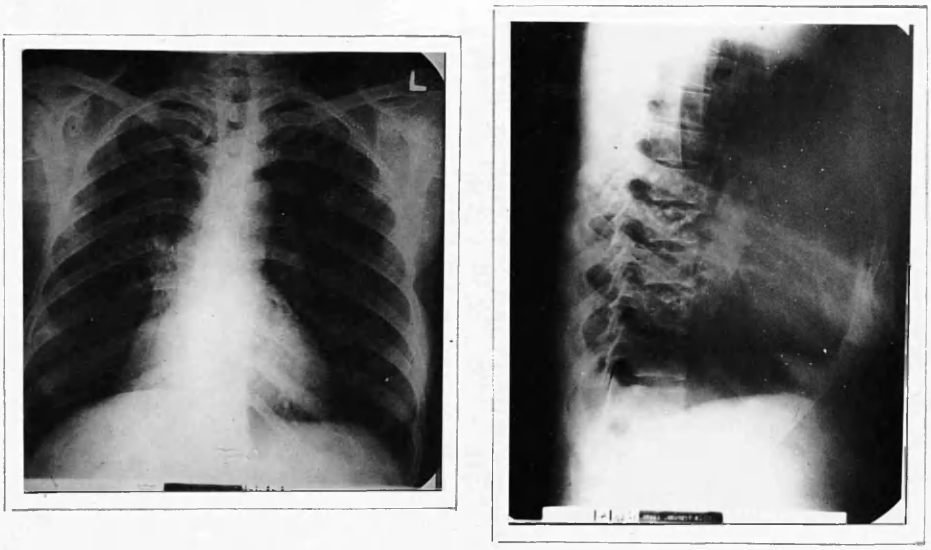


Fig. No.142. A triangular shadow is seen in the medial aspect of the right lower chest. This is due to partial atelectasis of the middle and lower lobes which has caused elevation of the diaphragm. The lateral film shows more atelectasis in the middle than in the lower lobe.

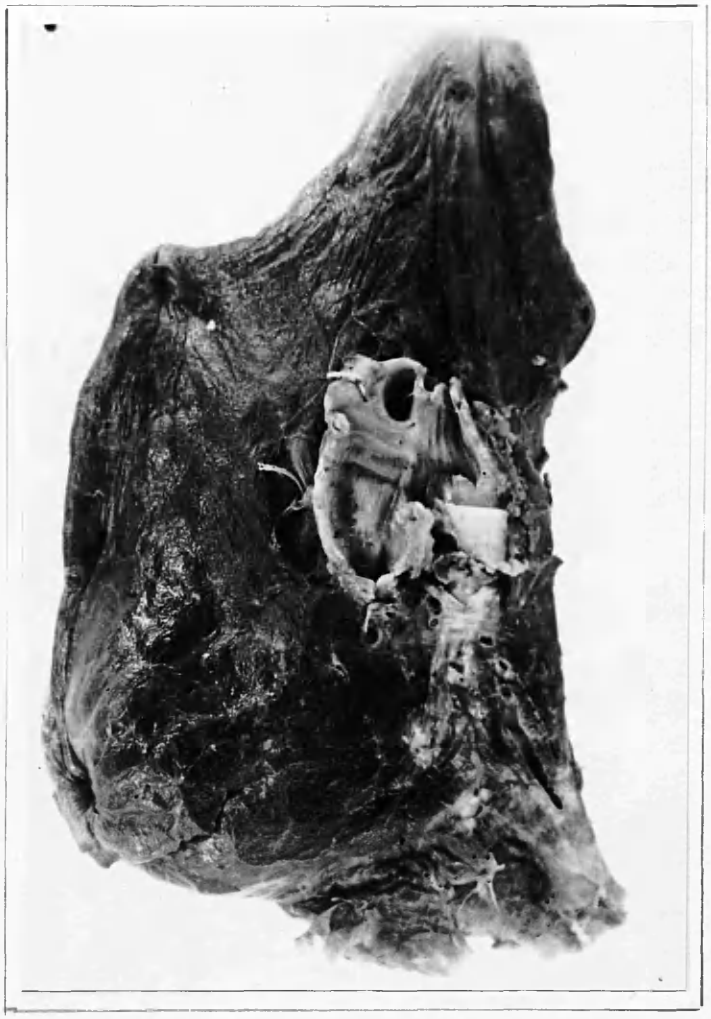


Fig. 143. The stem bronchus has been cut longtitudinally and opened out to show the adenoma blocking the stem bronchus just below the origin of the upper lobe bronchus. The tumour is mainly intra-bronchial. The lower lobe is atelectatic and pneumonic. Tissue for histology has been cut, thus causing the horizontal white line across the tumour.

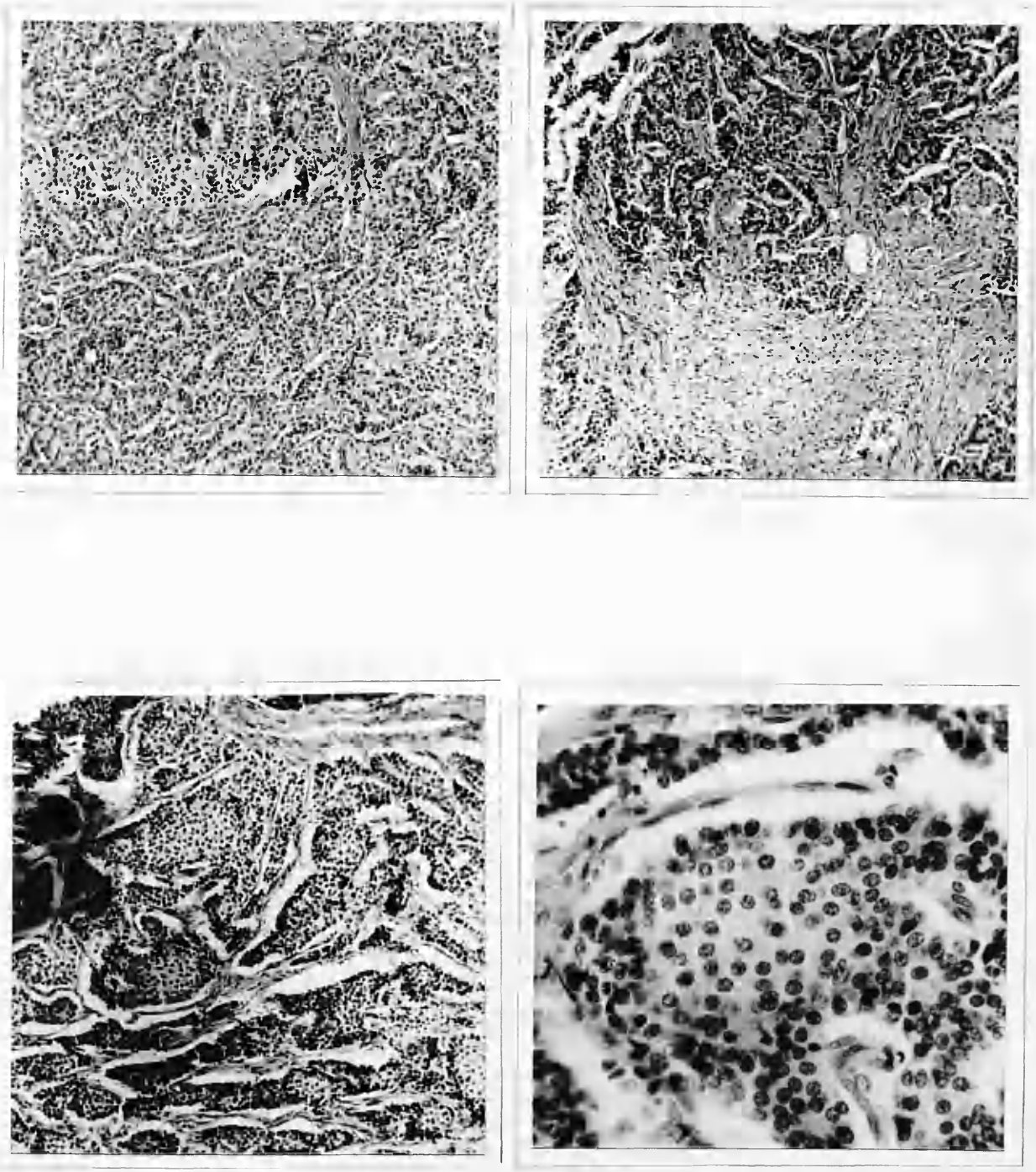


Fig. No.144. Representative areas of the tumour. In some the cell pattern is regular and typical of adenoma; in others the pattern is stragglingly uneven and suggests invasion. This is the case which was originally diagnosed as oat cell carcinoma.

Case No. 46.

A.B. (38). Occupation - Housewife.

Admitted 3.5.43,

Dismissed 9.7.43.

Diagnosis Adenoma of lung.

History. Two months prior to admission she developed a cold with a troublesome cough. She was ill for six weeks. Since then she had been fairly well. When she had the cough it had been worse at night, and only in the later stages was there much sputum.

Eight weeks prior to admission she had had a haemoptysis of about a teaspoonful of bright red blood; two weeks later a similar haemoptysis occurred. At this time she had no cough. She had had slight loss in weight, but there had been no night sweats, no anorexia and no pain in her chest.

Previous health. She had had pleurisy 15 years previously, and in childhood had had whooping cough and measles.

Examination. She was a fairly well built woman of good colour, with no cyanosis but slight clubbing of the fingers.

Respiratory system. The chest was well formed and moved symmetrically on respiration. There was some

slight impairment of percussion over the right lower zone. No adventitiae were heard.

Cardio-vascular system. The pulse was regular in rate and rhythm and the force was good. Cardiac dullness was within normal limits. The heart sounds were pure and of good quality. There were no adventitiae, but partial reduplication of the second pulmonic sound was heard.

Alimentary system and genito-urinary system showed no abnormality.

4.5.43. X-ray Report, Dr. Hurrell. "There is a rounded mass in the right lower zone lying close to the ribs posteriorly. The definition of the mass is fairly good. The appearances suggest an angioma, but an alveolar type of neoplasm is also possible".

7.5.43. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Trilene.

The chest was opened through a right postero-lateral incision. The tumour was found lying in the right lower lobe, it was fairly well circumscribed and was partly adherent to the posterior wall of the thorax. There were some adhesions between the upper lobe and pleura, and these were not broken down.

A lower lobe lobectomy was carried out and the chest was closed, without drainage. Two pints of group "A"

blood and two pints of plasma were given.

A course of sulphadiazene was commenced and in all 63 grams were given in the course.

8.5.43. The chest was aspirated and 685 c.c. of sero-sanguinous fluid removed. Further aspirations were carried out until 17.6.43 when pus was obtained and a drainage tube was inserted.

During this time the lung gradually re-expanded and on 9.7.43 she was discharged home in a satisfactory condition.

Pathological Report, Mr. K. Fraser. Specimen: "This shows a white tumour situated in the upper aspect of the lower lobe of the lung. The tumour is circular and is 5 cm. in diameter. It has a clear cut edge and appears to be almost encapsulated, although this appearance is due to lung tissue being compressed and atelectatic, the result of being pushed aside by the tumour. The growth is necrotic and breaking down in the centre".

Histological Report, Professor Shaw Dunn. "This is a small round-celled adenocarcinoma, which shows some tendency to papillary arrangement and which, at one point, shows invasion of the bronchus.

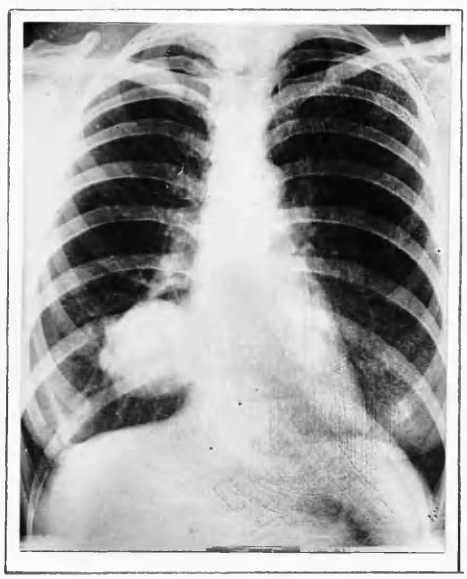
There may be an element of oat-celled carcinoma in it but it is not obvious. The growth appears to

be of low grade malignancy; it contains a fair amount of fibrous tissue stroma".

Prior to Professor Shaw Dunn seeing the sections, Dr. Lendrum had kindly seen them, and while agreeing with the above report he felt that a kidney origin for the tumour could not definitely be excluded.

This patient lived for five years when she died of a carcinoma of the breast.

In reviewing the subsequent history of this case it would seem that greater significance should be attached to the papillary architecture in the tumour and its relatively abundant fibrous stroma, features which support the clinical impression that this case behaved like one of bronchial adenoma rather than bronchial carcinoma.



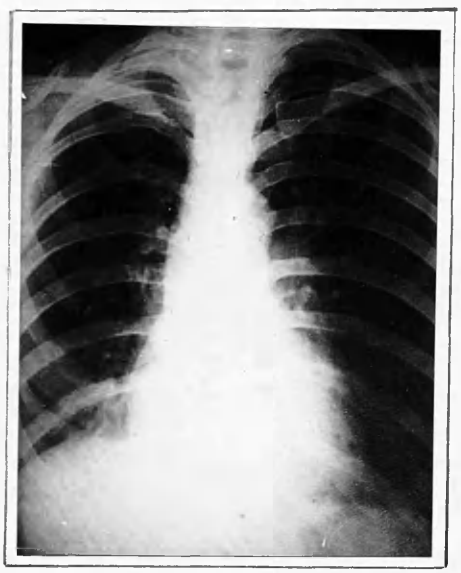


Fig. No. 145. The large round shadow present in the photograph on the left is due to an adenoma of large size. On the whole, it has a clear cut well defined edge unlike bronchial carcinoma. The photograph on the right was taken after the tumour and the right lower lobe had been removed.

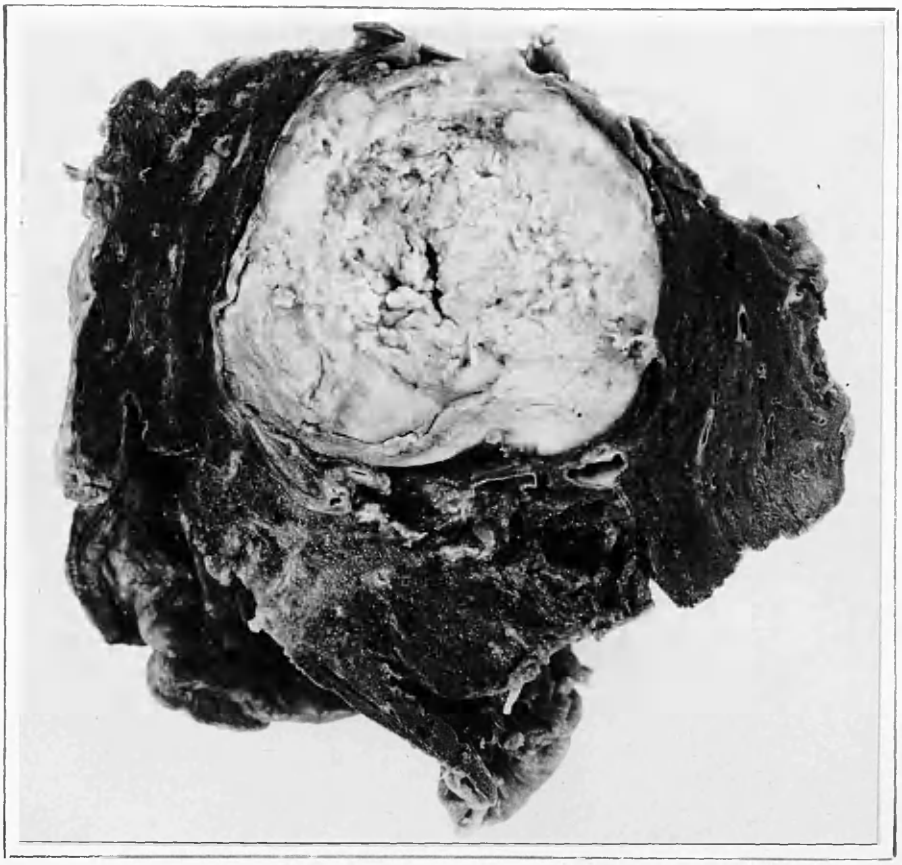


Fig. No. 146. The lower lobe has been cut across. The white tissue of the adenoma is seen to occupy a large part of the upper portion of the lobe. It is 5 cm. in diameter; it shows central breakdown and it has compressed the adjacent lung tissue into a false capsule.

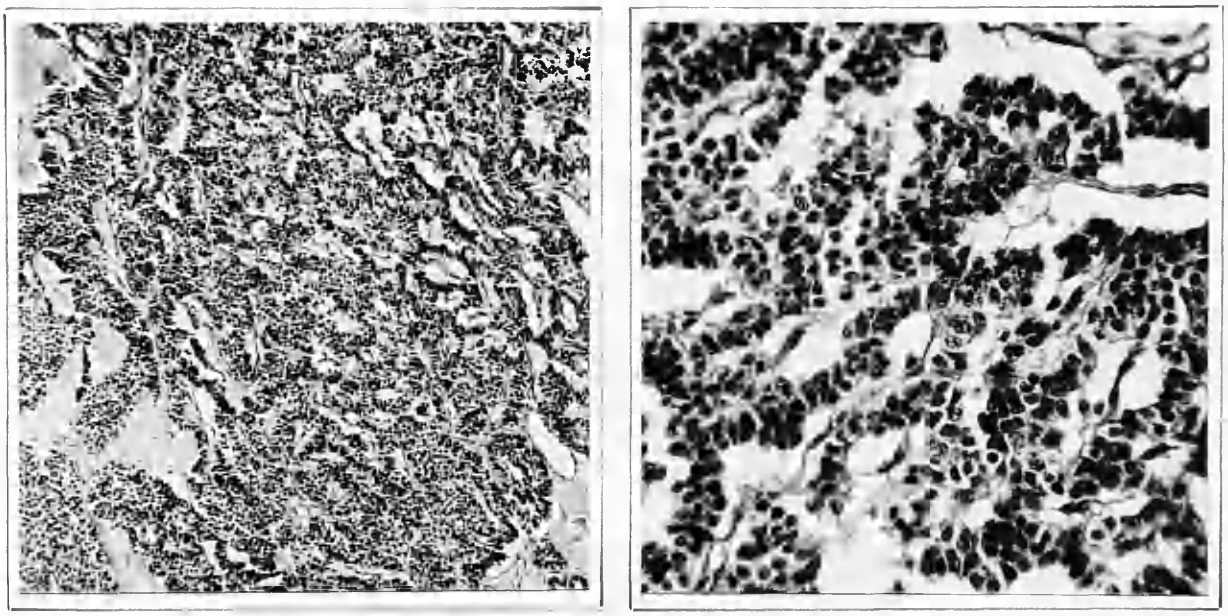


Fig. No. 147. In some areas the cells are arranged in columns, in others they are arranged in closed acini. The cells are small and most of them have a rounded central nucleus. There are many cystic spaces and there is fine fibro-vascular stroma.

Case No. 47.

M.B. (36),

Admitted 2.1.51,

Dismissed 27.4.51.

Diagnosis Pulmonary adenomatosis.

History. About July 1950 she began to be tired and lacking in energy. At the end of July she had a sudden shivering attack and this was followed by a bout of coughing with production of frothy sputum. She went to bed and stayed there for 27 days with a fever and a cough with white frothy sputum and pain in the right lower chest on deep breathing. Later this pain shifted to the right shoulder and required injections of morphia for relief. Her sputum was never yellow or purulent nor had it been blood stained. She was treated with sulphonilamides but made only a partial recovery from this illness, the cough, spit and chest pain persisting. In November, she was admitted to the Infectious Diseases Hospital, Dumbarton, where her symptoms became worse. She improved slightly on penicillin, but the pain and lack of energy persisted, and x-ray appearances of the chest did not improve. At the time of admission to Hairmyres she was very lacking in energy and produced two to three cupfuls of sputum daily, the sputum being white and

frothy, it came up very freely all day and she had a dull pain at the right base, worse on deep breathing. There were no abdominal symptoms.

Previous health. She had had rheumatism from age 16 to 21, occurring in intermittent attacks. She was treated in hospital on one occasion for six weeks. She had Vincent's Angina when 27. She had some blood pressure and kidney trouble with her first pregnancy. She had four live children, the first child having died, the youngest being 1 year and 9 months.

Examination. A fairly heavily built woman. She was slightly breathless in bed and there was no finger clubbing or cyanosis.

Respiratory system. There was limitation of expansion at the right base where the vocal fremitus was increased as it was in the right axilla. The percussion note was impaired in these areas. The respiratory murmur was bronchial over the right lower lobe and in the right axilla. The sounds were accompanied by showers of fine crepitations at the height of inspiration. Over the right upper lobe the sounds were vesicular. At the left base there were crepitations at the height of inspiration with a ? pleural friction rub. The vocal resonance showed bronchophony at the right base most

marked just below the inferior angle of the scapula. The blood pressure was 110/80, otherwise the heart and central nervous system were normal. B.S.R. 27 mms. in the hour.

4.1.51. X-ray Report, Dr. Donald. "There is a marked degree of collapse with some consolidation of the right middle and lower lobes. Cause at present indeterminate".

10.1.51. Bronchoscopy, Dr. Semple. "Trachea and carina normal. Left stem bronchus normal. Right bronchial tree normal except that the right upper lobe orifice is more obvious than normal due to partial collapse of the right lower lobe. There is much continuous flowing of clear mucus exuding from the apical segment orifice of the right lower lobe. All the other orifices were normal and dry".

15.1.51. There was very copious frothy sputum - 18 to 20 ounces daily. Clinically, there was little evidence of fluid at the right base. Broncho-pleural fistula is thought to exist to account for the copious frothy sputum, she is receiving 2 million units of penicillin daily.

27.1.51. X-ray Report, Dr. Donald. "Bronchogram. No oil has entered the right middle or lower lobe. Upper lobe outlines normally".

13.2.51. Operation - Mr. Dick, Mr. Fraser.

Dr. Robson -
Pentothal,
Cyclopropane,
Gas & Oxygen.

Left bronchus blocked. The right hemithorax was opened through the bed of the 7th rib, which was resected. There was a free pleural space in the upper part, but the lower lobe was adherent to the chest wall and diaphragm. The lower lobe was entirely replaced by a firm carneous mass which was broken into when attempting to strip the lower lobe from the diaphragm. The exposed tissue resembled placental tissue but in areas had a firm papilliferous appearance.

The lower lobe bronchus was first secured and clamped. It was divided between two clamps and the proximal end was closed with an atraumatic continuous silk suture reinforced with silk mattress sutures. The artery and then the vein to the lobe were now ligated with catgut and divided between silk transfixion sutures. The lower lobe was removed but parts of the firm tissue were left adherent to the diaphragm. Although it was seen that the medial segment of the middle lobe was affected by a similar indurated mass, this lobe was not removed.

Penicillin-sulphamethazine powder was applied to

the hilar area; the chest was closed in layers and a de pezzer catheter was left in situ. 250,000 units of penicillin were left in the chest.

15.2.51. The right upper and middle lobes remained well expanded. Sputum now minimal. Drainage 3 ounces daily.

15.2.51. Pathological Report, University of Edinburgh, Dr. Dawson. "There were three fragments of tissue. On section, the tissue was yellowish in colour, soft and finely lobulated. It did not have the usual appearance of tuberculosis and looked much too cellular for a bronchogenic carcinoma. The retention of the lobulated pattern suggested that the tumour, and it certainly looked like tumour, was spreading in the alveoli without affecting the sector between the bronchioles or lobules. Portions of each of the three tissues were taken for examination.

Histology. No evidence of tuberculous infection. All three areas show an adenomatous tumour of highly complex glanduliform and papillary structure. Defined rounded masses of this tumour tissue are separated by fibrous bands in which the unaffected bronchi are embedded. There is no obvious invasion of these fibrous septa. A little mucus is present in some of the glandular formations. No mitoses are obvious in spite of the cellular complex

growth.

This report is urgently requested, as a provisional diagnosis. The growth suggests an unusual type of adenoma, largely undifferentiated re mucus secretary function, but with no definite evidence of infiltrative or malignant character. But it needs further study, and as lobectomy has been done, this urgent report is, I hope, adequate meantime. Differential staining may be helpful and will be done".

21.2.51. She had been running a continuous pyrexia since her operation and the cause of this was not apparent. She was put on to chloromycetin 0.25 grammes q.d.s.

24.2.51. Her pyrexia still remained uninfluenced and it was noted that both ankles were oedematous and that both calves were tender on deep pressure. She was put on to tromexan 0.3 gramme twice daily, but this produced a prothrombin activity of 25 to 27% and the dosage had to be cut accordingly. The right leg eventually cleared of its oedema, but the left leg became grossly oedematous, congested by venous blood, and extremely painful, the whole leg being involved.

7.3.51. The left leg was less oedematous and her general condition was improving.

29.3.51. Sputum stained routinely showed no tumour cells but by the periodic acid Schiff technique a few cells

were seen almost certainly derived from tumour.

25.4.51. Allowed home. The oedema of the leg has now practically gone. General condition fairly good.

16.5.51. Reported to-day. She is not looking well. Her cough is troublesome and she had abundant purulent sputum. Moisture is obvious in the left as well as the right lung.

She died at home three months later.

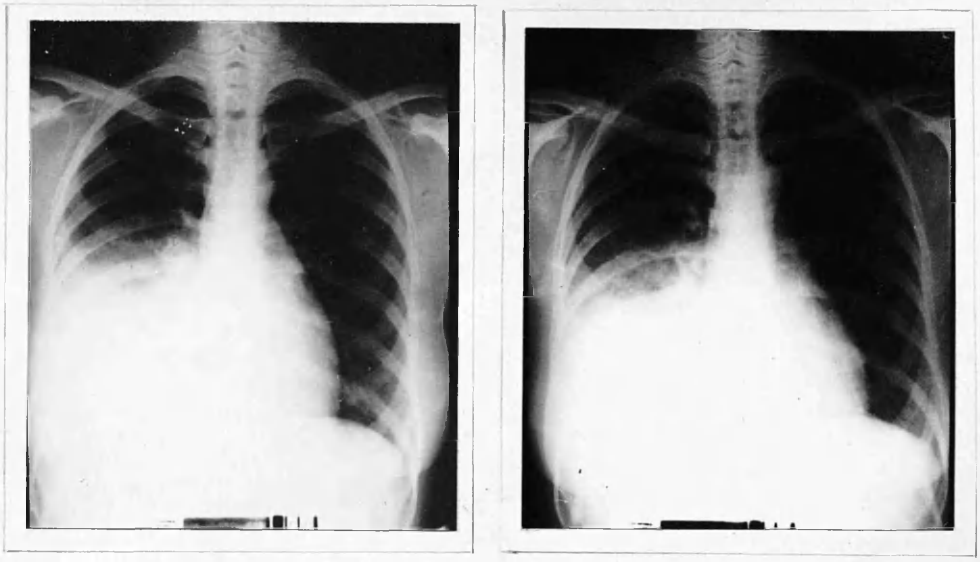


Fig. No.148. The x-ray photograph on the left is the first x-ray taken of this case. It shows consolidation of the right lower lobe. The photograph on the right was taken six weeks later just before operation; some tumour nodules can be seen in the upper lobe.

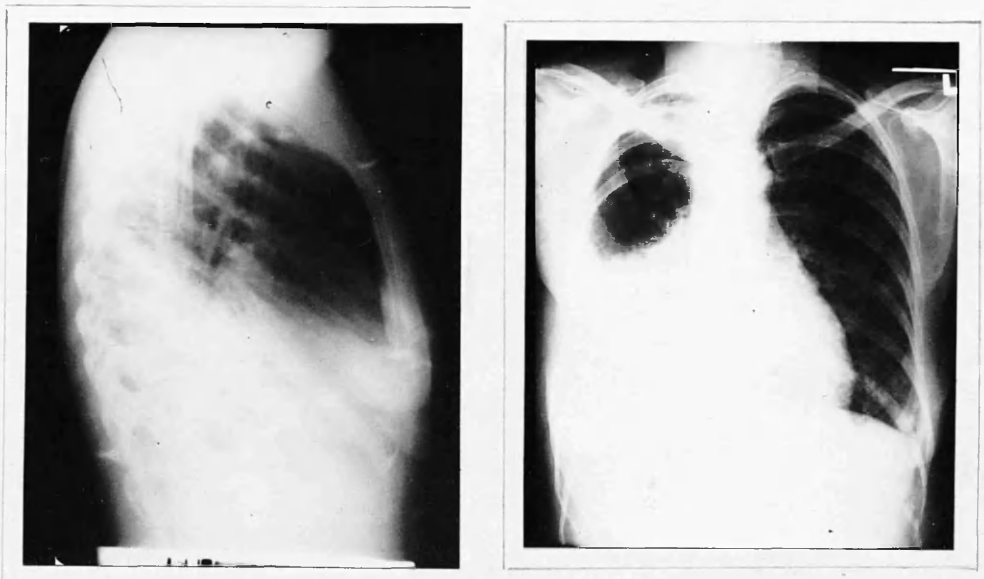


Fig. No.149. The picture on the left is a lateral X-ray taken at the same time as the most recent pre-operative film above. The picture on the right was taken four weeks after the operation. Already tumour nodules can be seen in the right upper lobe and in the left lung.

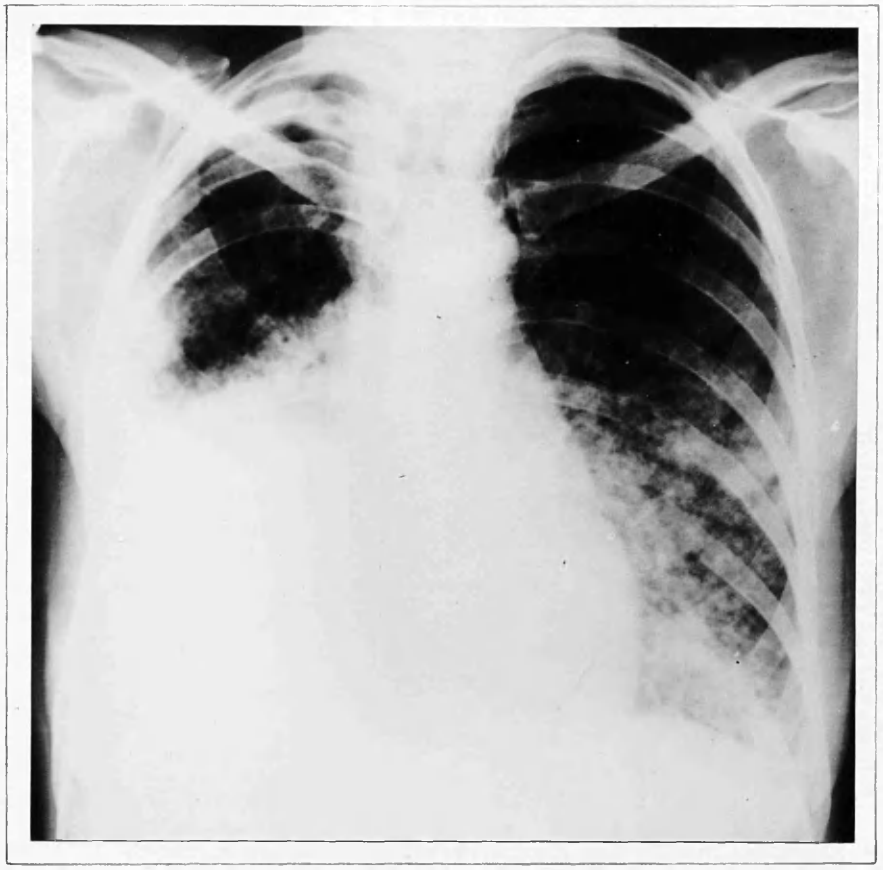


Fig. No.150. The x-ray appearances two months after operation. Many tumour nodules are seen in both lungs.

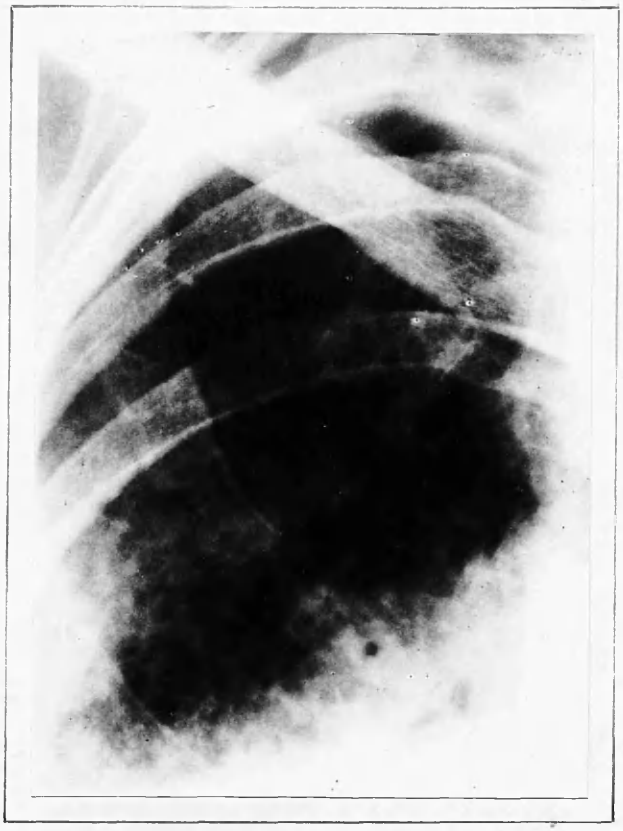


Fig. No.151. An enlarged photograph of the left upper lobe taken from Fig. No. 150.

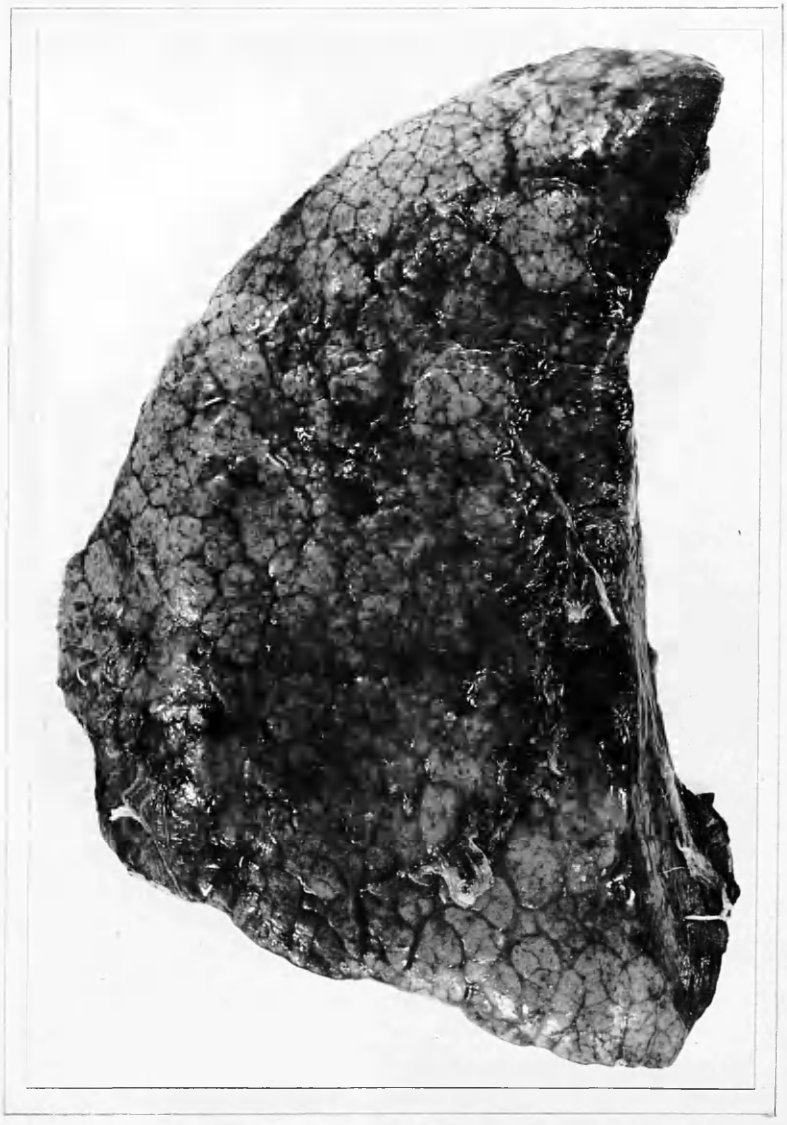


Fig. No.152. The external aspect of the pulmonary adenomatous lobe. The tumour lobulation and intact pleura are well seen.

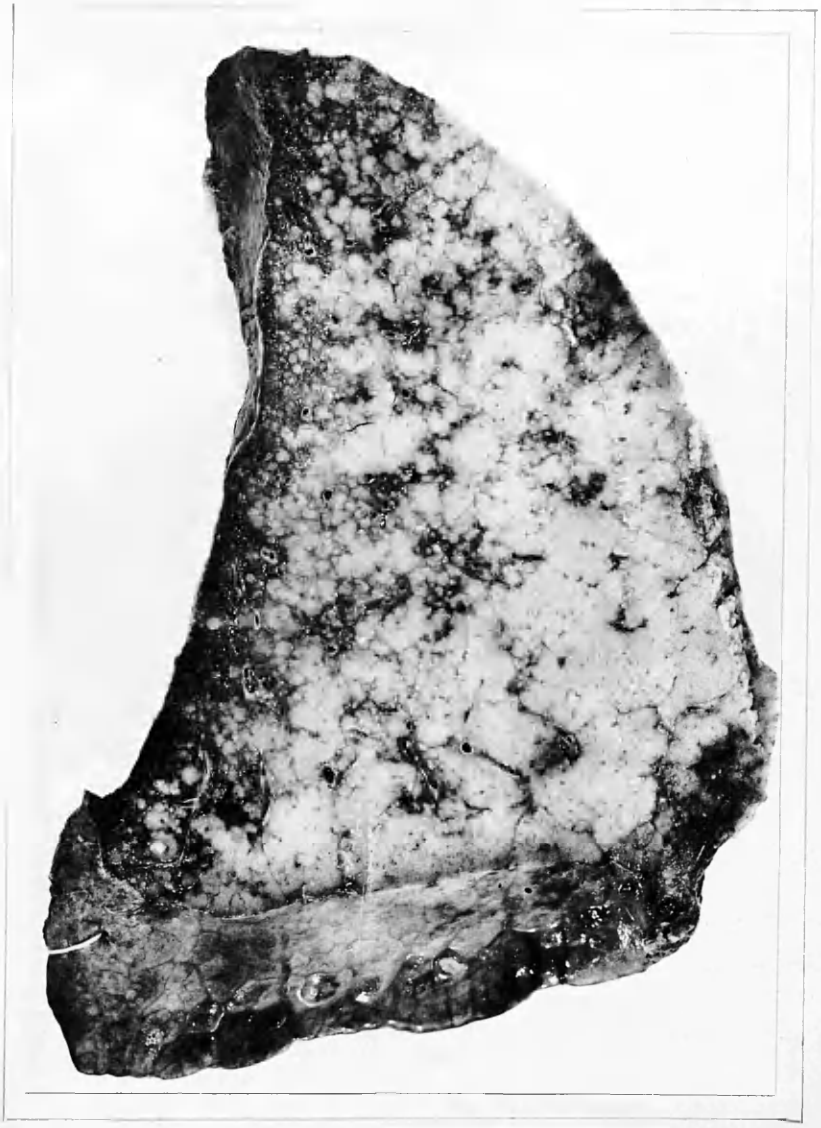


Fig. No. 153. The cut surface of the lobe. Towards the inferior aspect of the lobe many small tumour nodules have coalesced; towards the superior and peripheral aspects many fine gradations of tumour nodules are seen.

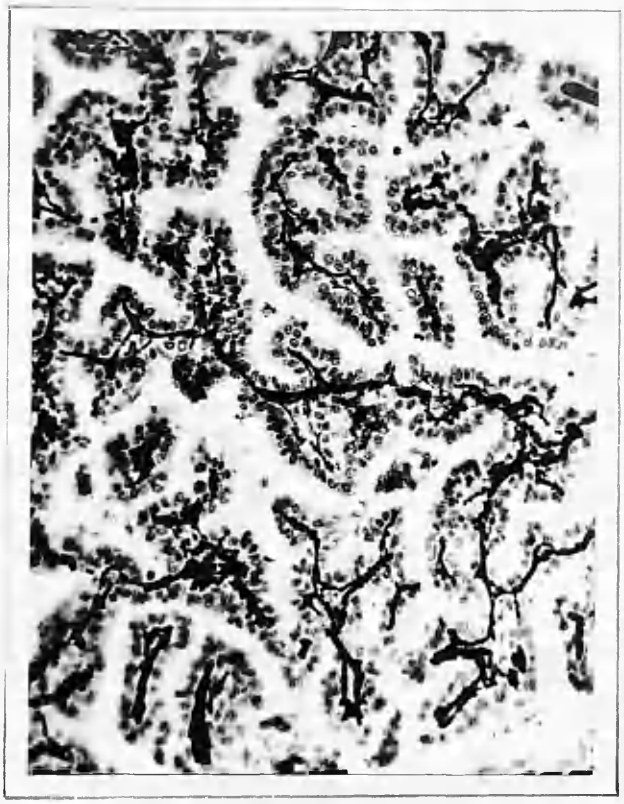


Fig. No. 154. Photomicrograph stained for reticulum to show the fine stroma.

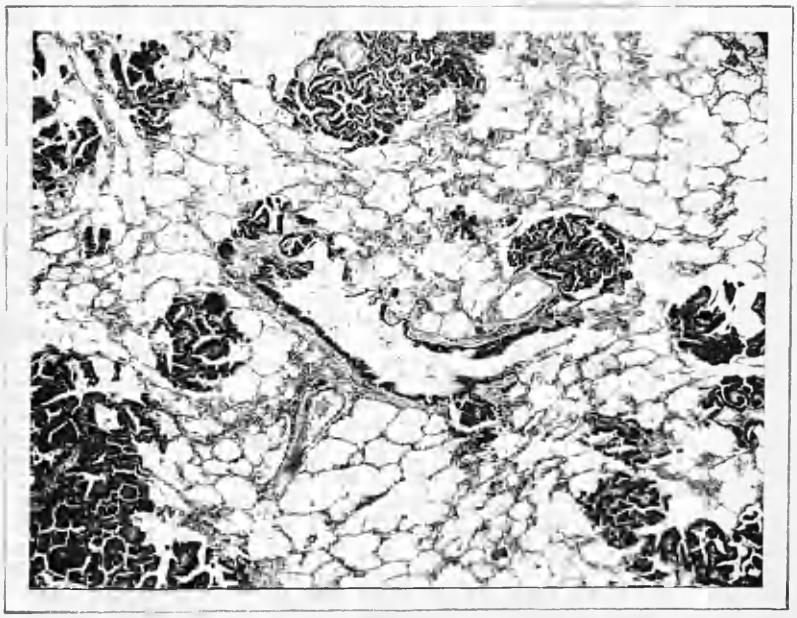


Fig. No. 155. The appearances seen in an area containing many as yet small tumour nodules. Two of these nodules can be seen in relationship with a small bronchus.

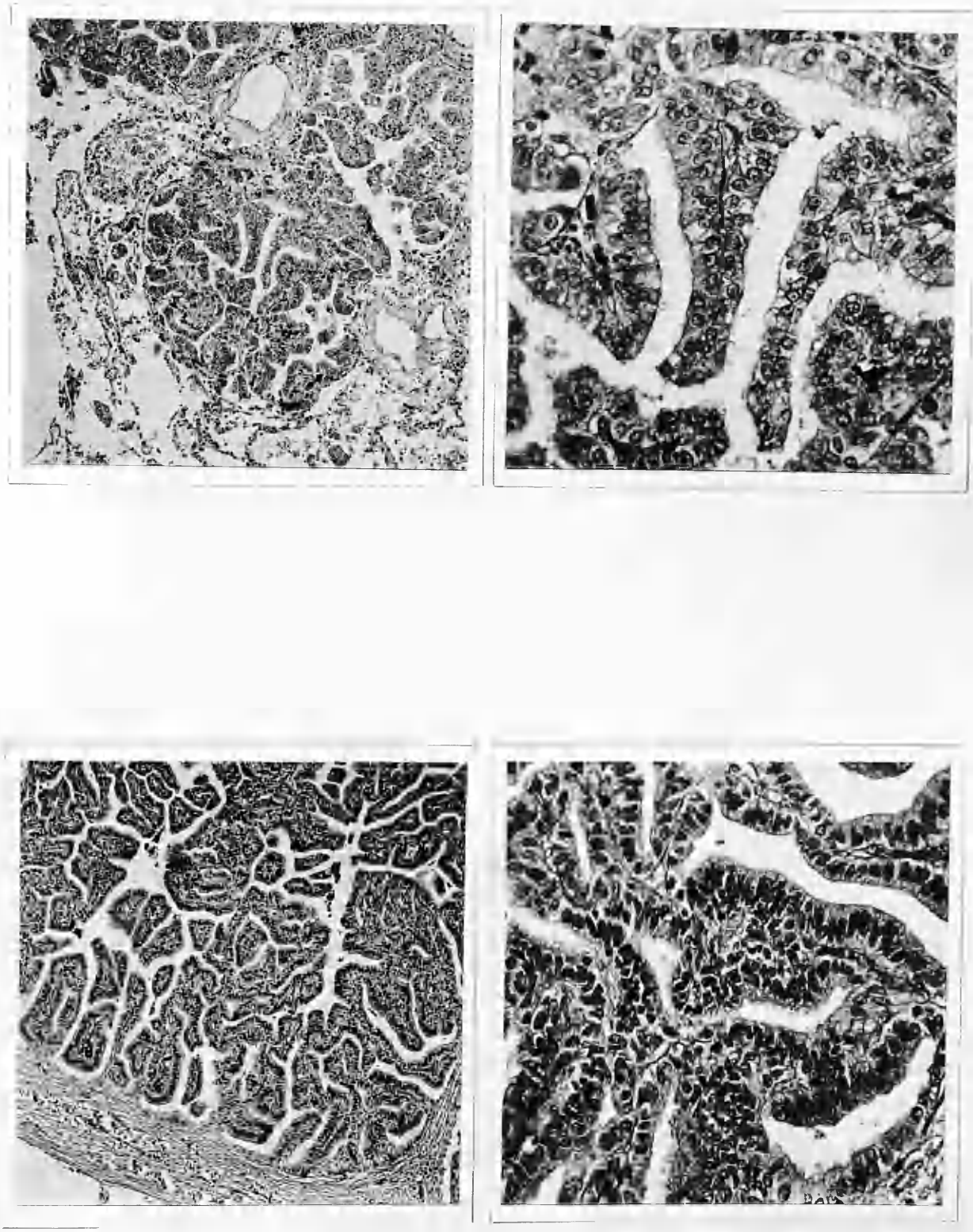


Fig. No.156. Representative fields to show the alveoli lined by tumour cells.

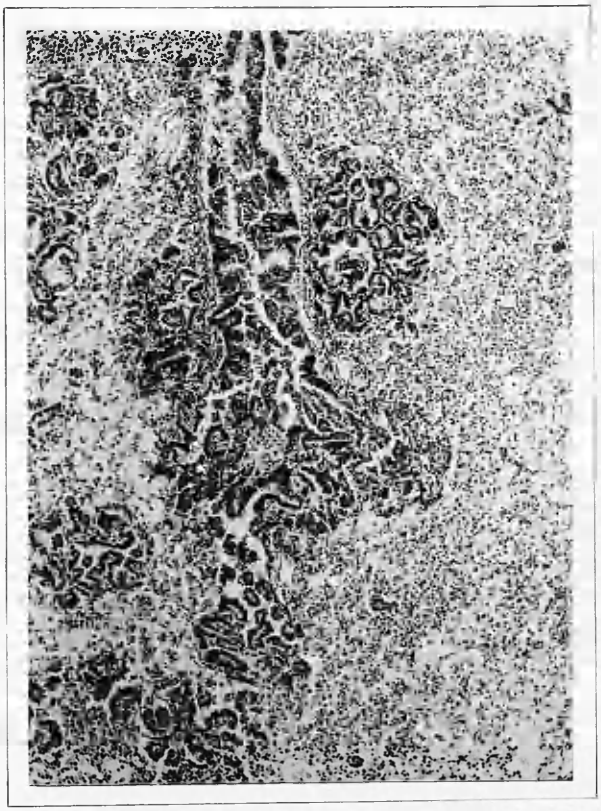


Fig. No. 157. Photomicrograph of sheep lung jaegsickte to show the similarity of the two conditions.

MALIGNANT TUMOURS.

Case No. 48.

D.P. (43). Occupation - Monumental Mason.

Admitted 23.5.50,

Dismissed 26.7.50.

Diagnosis Bronchial Carcinoma.

History. Four months prior to admission he had felt well and was free of chest symptoms apart from morning cough of some years standing and which he ascribed to smoking. One day he was doing some heavy digging in his garden and afterwards felt that he had over-taxed his strength. That evening he developed an aching pain in the left chest about the level of the nipple. The pain was aggravated by movement and coughing but was fairly mild if he lay quiet. It became steadily worse over the following two days and he was forced to remain in bed to obtain relief. On the fourth day he coughed up a little blood stained sputum. The pain then abated, until he was only having twinges of pain on moderate exertion. His cough had increased slightly and he began to cough a little at various times of the day. His sputum became a little more copious. By the time he had developed his chest pain, he was feeling unfit for his work and unusually tired on wakening in the morning. He did not think he had lost weight. He was

not breathless on exertion but stated that he had been taking things more easily and walking more slowly.

Examination. He was found to be a well nourished man of rather pale complexion. There was no cyanosis, oedema or jaundice. One or two small glands were palpable in the axillae. There was no clubbing of his fingers.

Respiratory system. The chest was well developed and moved symmetrically. There was no dullness to percussion. The breath sounds were of normal type. The clinical findings in the chest were essentially negative. Other systems showed no abnormality.

24.5.50. X-ray Report, Dr. Donald. "There is a circumscribed opacity extending upwards from the left hilum. The appearances suggest bronchial neoplasm. A penetrated film of the left side of the chest shows that the tumour mass probably extends medially towards the mediastinum. A barium swallow showed no evidence of enlarged mediastinal glands".

25.5.50. Bronchoscopy, Dr. Semple. "Trachea normal except for slight bulging of left lower lateral wall. Carina normal. Both stems normal and upper lobe segmental orifices well visualised.

Conclusion - No direct evidence of neoplasm,

but possible indirect evidence of hilar gland involvement".

6.6.50. Operation - Mr. Fraser, Mr. McCluskie.

Dr. Pinkerton -
Pentothal,
Cyclopropane,
Gas & Oxygen.

The left chest was opened using a postero-lateral incision with resection of the 6th and 7th ribs and conservation of the intervening intercostal bundle. The lung was free apart from some fine adhesions between the upper lobe and the chest wall. The tumour was bulky but although encroaching well into the hilum of the lung it did not involve the main bronchus, artery or vein. Pneumonectomy was therefore carried out, securing first the pulmonary artery, then the inferior vein followed by the superior vein and finally the bronchus. The vessels were closed with a cat gut ligature and a silk transfixing suture. The bronchus was sealed, using a continuous atraumatic silk suture. Closure was re-inforced by suturing the anterior end of conserved intercostal bundle to the bronchial stump. On completion of the pneumonectomy it was possible to feel a large firm gland lying alongside the left lateral wall of the trachea, just above the left stem bronchus. It could not be removed safely. Penicillin-sulphathiazole

powder was applied to the hilum after instillation of penicillin and the wound was closed with a posterior drainage tube.

Following operation he was rather slow to regain his blood pressure and required 4½ pints of blood.

7.6.50. His general condition was satisfactory.

8.6.50. Moist sounds were heard over main bronchi and trachea without the stethoscope. Obviously there was sputum present but he was not able to cough it up, despite posturing and chest support. He was therefore bronchoscoped under local anaesthesia, and some muco-purulent material aspirated. General condition was good.

9.6.50. Pathological Report, Royal College of Physicians, Dr. Dawson. "Lung tissue - An undifferentiated epidermoid carcinoma of rather small cell type with no squamous or keratinised features. The growth is very cellular and infiltrative and permeates all the tissue sent and shows numerous mitotic figures. There is no lung parenchyma present. The supporting tissue shows much pigment (carbon) injection and active fibrosis.

The mediastinal lymph gland is almost entirely replaced by an even more cellular and active malignant tissue".

10.6.50. The chest was much drier but there was still unexpectorated material present.

16.6.50. Pathological Report, Mr. K. Fraser. "On one aspect of the cut lung there is a tumour 6.5 x 3.5 cm. of white appearance with here and there in its lower portion greyish stippling due to gland invasion. The tumour appears to have reached the fissure but has not transgressed it. On the other aspect of the lung the tumour shows itself as a 4 x 3.5 cm. wide area with obvious invasion of a large gland which is lying immediately above the stem bronchus. The tumour was found to tightly encircle the main pulmonary artery, although it has not actually invaded into the artery lumen".

17.6.50. He had 1500 c.c. of blood stained fluid aspirated and penicillin replaced. His voice had been husky following the operation and was now improving.

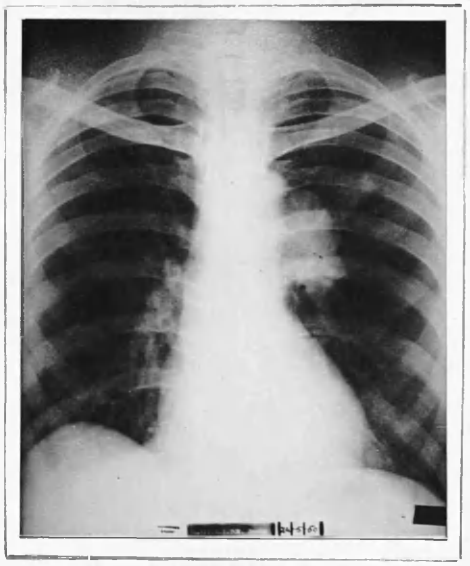
11.7.50. He was examined by the Ear, Nose and Throat Surgeon, who found a complete abductor paralysis of the left vocal cord.

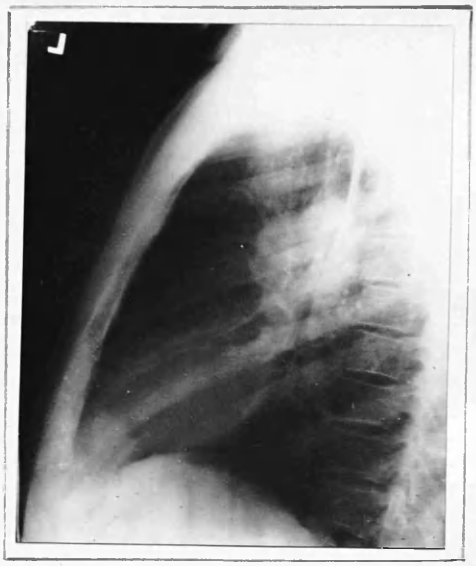
26.7.50. He was transferred to Glasgow Royal Infirmary for X-ray therapy.

6.9.50. He reported. His general condition was

satisfactory. He had put on three pounds in weight. 25.9.50. He was seen by Mr. Fraser on a domiciliary visit, when he had developed a transverse myelitis due to a secondary spread to his spinal meninges. He had retention of urine and retention of faeces.

On examination, he appeared to be tender over the region of his 10th and 11th dorsal vertebrae. 26.9.50. He died.





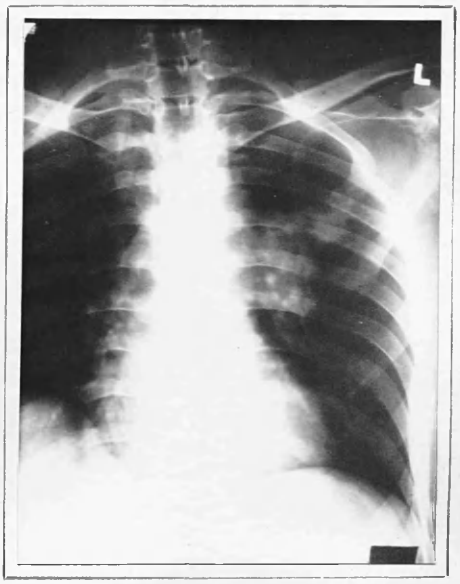


Fig. No.158. The tumour shadow is well seen at the left lung hilum. The fact that the tumour is hilar is confirmed by the lateral X-ray photograph which shows it to be in the mid-zone (in fact encircling the hilar structures). In the centre of the tumour shadow there is a small slit of air - running upwards from this point can be traced the air shadow of the trachea - this confirms the hilar site and would have weighed heavily against operability had it not been that the patient was a doctor's relative and operation was requested. The lower X-ray shows more penetration.

Fig. No.159. The stem bronchus has been cut across just as it enters the lung. The pulmonary artery is seen as an obliquely placed slit directly above the bronchus. The white tumour tissue can be seen to tightly encircle the artery (no actual invasion of the arterial lumen was found). To the right of the tumour and at 10 o'clock from the bronchus a large invaded gland is visible. This photograph of the specimen gives an almost exact mirror image of the lateral X-ray photograph. On the X-ray the tumour is above and to the right of the bronchus while the invaded gland can be seen above and in front.

Fig. No.160. A deeper cut has been taken into the lung and the specimen has been reversed. The circular white areas above and to the right are due to tumour tissue; the circular stippled area just below the centre of the tumour is an invaded gland. The tumour has reached the fissure but has not transgressed it.

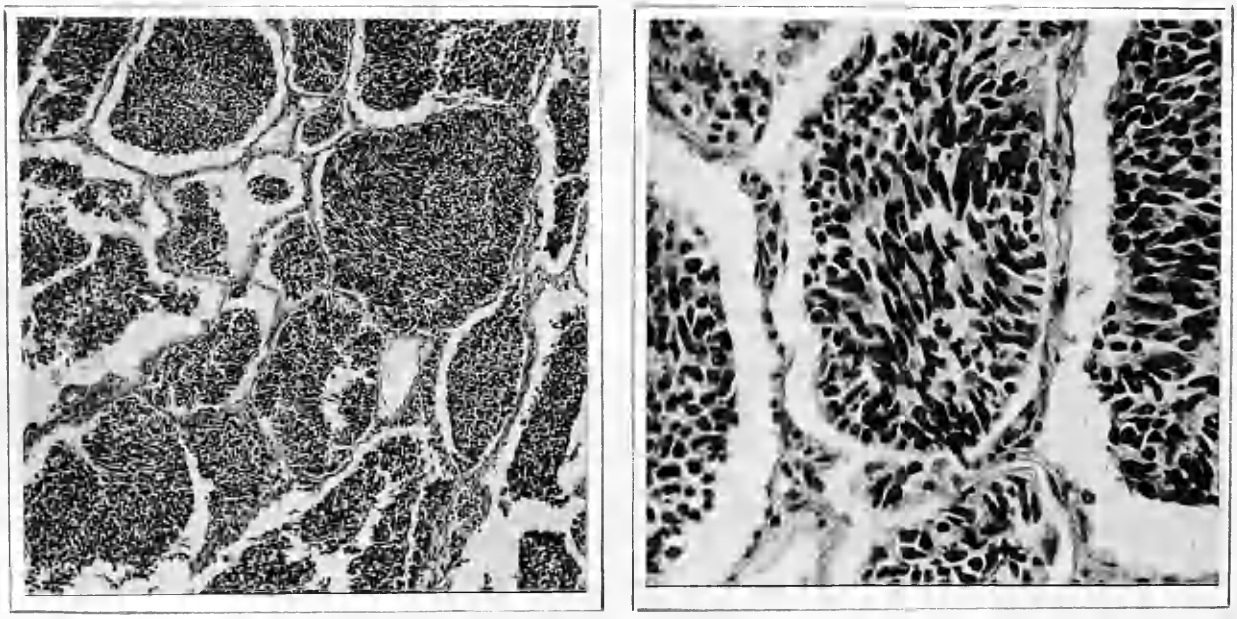


Fig. No. 161. The tumour is an oat-cell carcinoma which has choked the lung tissue. The cells show great variation in shape and size. Some mitotic figures are visible.

Case No. 49.

J.C. (59), Occupation - Boiler & Steam Pipe coverer.

Admitted 25.10.47.

Died 13.11.47.

Diagnosis Bronchial Carcinoma.

History. He was in good health until 2 years prior to admission when he began to notice breathlessness after exertion which became progressively worse. At night there had frequently been a wheezy cough with the production, also by day, of mucoid sputum in small amounts. There had been no haemoptysis and no pain in his chest. He had not lost weight and his general condition had been good. He had only required to stop work shortly before admission in order to get hospital investigations carried out. For the previous four years the patient had been aware that the terminal phalanges of his fingers were altering. He had noticed that several of his workmates have had similar changes in the tips of the fingers.

Examination. He was in fairly good condition, but appeared to breathe almost entirely abdominally. There was no cyanosis, the fingers were markedly clubbed and there was no glandular enlargement.

Respiratory System. Expansion of the chest was poor. The percussion note was resonant although there was an area of dullness over the right lower lobe. The breath sounds were broncho-vesicular and of diminished intensity over the right lower lobe where the vocal resonance and vocal fremitus were diminished.

Over this area crepitations were present. Sibilant rhonchi were heard throughout both lungs.
The cardio-vascular system was normal.
28.10.47. X-ray Report, Dr. McKail. "There is an area of homogeneous density of ovoid shape in the axillary pectoral segment of the left lung, upper lobe. It measures 6 x 5 cms. and its margins are rather poorly defined. The fine diffuse opacity seen in both lung fields suggests pneumoconiosis. The mass in the left lung has the appearance of a bronchial carcinoma".
29.10.47. Bronchoscopy, Dr. Semple. "Larynx, trachea and carina normal. Right stem bronchus normal. Left stem bronchus normal and viewed well down to distal orifices. Left upper lobe orifice well seen. The lips are rather red and slightly oedematous, but no tumour mass seen.

Conclusion - The neoplasm in left upper lobe does not involve the left upper lobe orifice nor does it apparently have mediastinal extension".
1.11.47. Operation - Mr. Dick, Mr. Fraser.
Dr. Pinkerton -
Pentothal,
Gas & Oxygen.

A left pneumonectomy was carried out. Two tubes were inserted into the chest and a gauze pack was placed over what appeared to be a small aneurysm. Penicillin was instilled into the chest, which was then closed.

13.11.47. He died.

Pathological Report, Mr. K. Fraser. "There is a tumour 6 x 5 cm. lying apparently between the anterior and lingular divisions of the upper lobe bronchus. The tumour has the appearance of gorgonzola cheese, being white and striated by green strands.

This is a squamous epithelioma showing moderate activity. The cells are grouped in rounded masses ("solid alveoli") these in turn are grouped together in much larger masses. The individual cells are large with rounded nuclei and one or more nucleoli. Mitotic figures are infrequent".

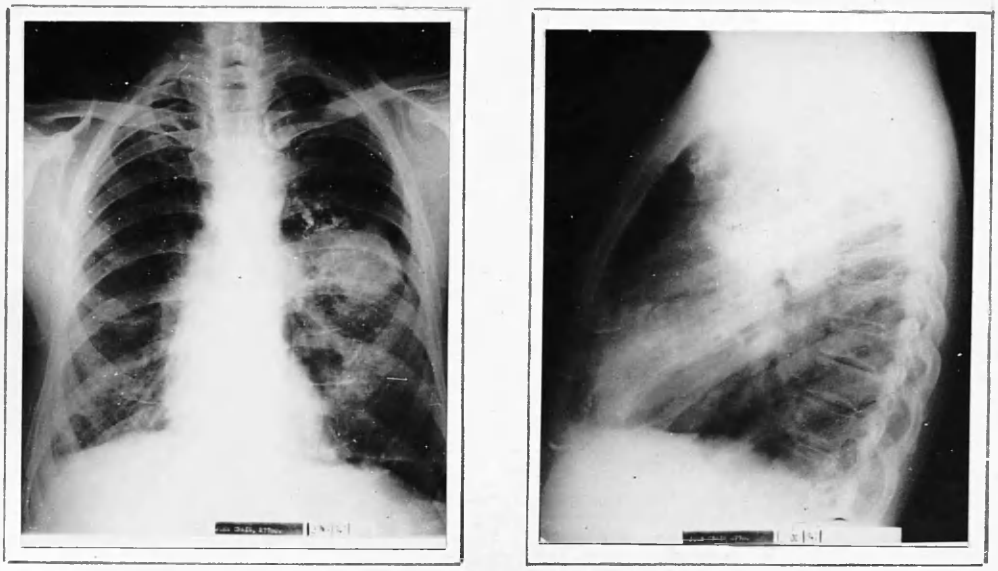


Fig. No.162. The tumour shadow lies between the anterior and lingular bronchial divisions of the left upper lobe. The finely "dusted" appearance of both lungs, especially in the lower lobes, could be due to pneumoconiosis. (He was a boiler and steam pipe coverer).

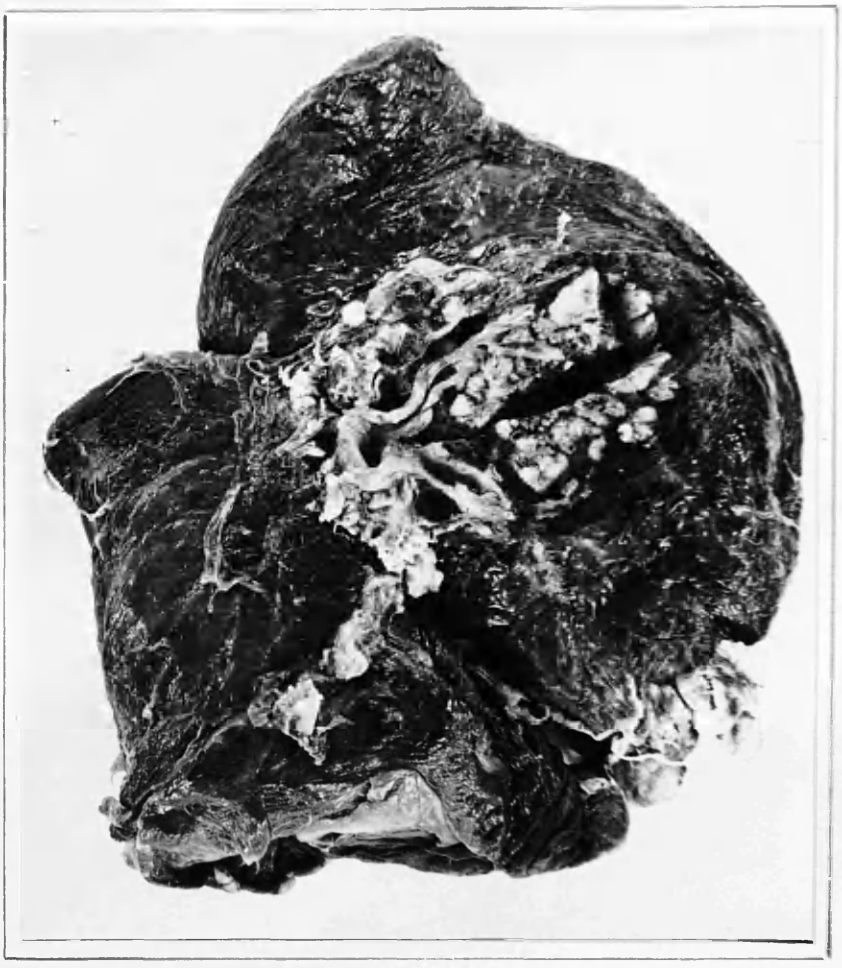
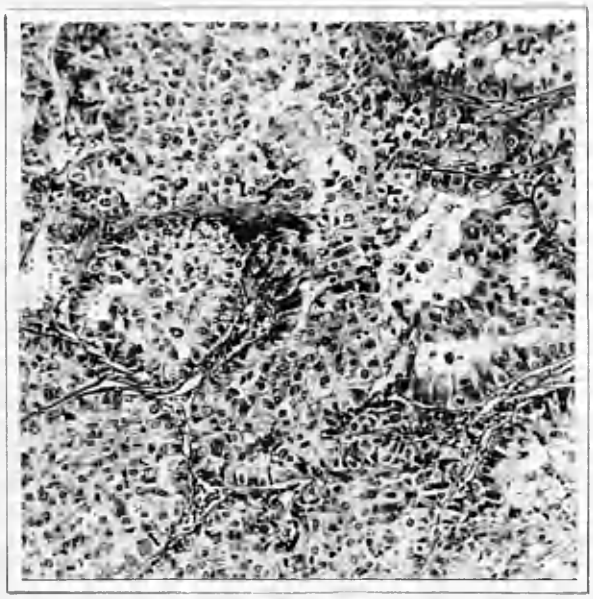


Fig. No.163. The upper lobe has been cut across to bisect the tumour in such a manner as to lay open the anterior and lingular divisions of the upper lobe. These bronchi can be seen to run above and below the tumour respectively. A wedge of tissue has also been removed from the centre of the tumour. The tumour was 6 x 5 cm. in size.



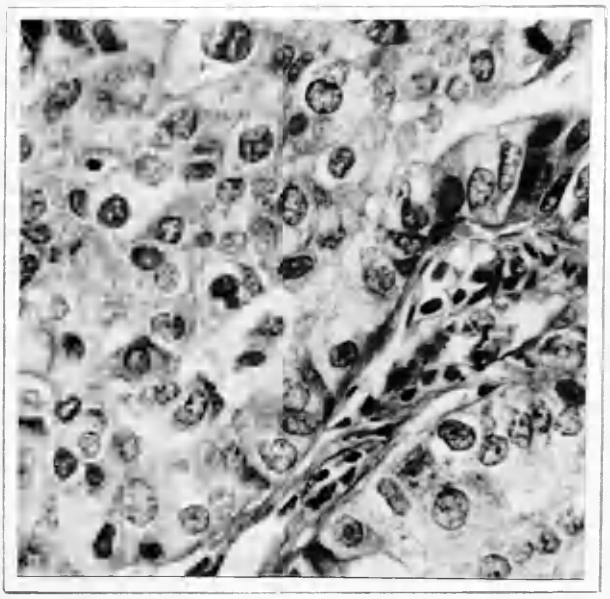


Fig. No. 164. The cells are grouped in rounded masses ("solid alveoli"); these solid groups of cells are aggregated together to form much larger masses. The centre of the masses frequently show necrotic foci. This is a squamous epithelioma of moderate activity.

Case No.50.

R.P. (45). Occupation - Draughtsman.

Admitted 14.8.48,

Died 8.9.49.

Diagnosis Bronchial Carcinoma.

History. Five weeks prior to admission he developed pain in the left chest just lateral to the sternum. The pain was dull in character. He had had some haemoptysis. He was admitted to Irvine Central Hospital on 9.8.48. His appetite had been poor for six months but he had not lost weight. He had been breathless on exertion for two to three months.

Examination. He was a well preserved, middle aged man. There was no cyanosis. The fingers showed slight clubbing.

Respiratory system. The chest movement was normal. There was a tendency to bronchial breathing over the left mid-zone anteriorly. No adventitious sounds were heard.

Cardio-vascular system, alimentary system and lymph glands showed no abnormality.

16.8.48. X-ray Report, Dr. McKail. "There is a spherical opacity of homogeneous density occupying the apical segment of the lower lobe of the left lung.

It measures roughly 8 cm. in diameter and its margins are poorly defined. It has the appearance of a bronchial carcinoma".

18.8.48. Bronchoscopy, Dr. Semple. "Trachea normal. Right bronchus and orifices normal. Carina sharp posteriorly, rather broadened and inflamed anteriorly. Left stem bronchus somewhat blunt. It is difficult to examine distal reaches in left upper lobe owing to much secretion and sensitivity. Seen down to distal orifices at one point - secretion obscured full view. Biopsy taken. Probably negative".

Royal College of Physicians Laboratory Report.

"1. Bronchial tissue with cartilage, submucosa and epithelial covering.

2. No evidence of malignancy".

7.9.48. Operation - Mr. Fraser. Dr. Pinkerton - Pentothal, Curare, Cyclopropane, Gas & Oxygen.

The chest was opened by the usual left postero-lateral incision and the pleura was reached by removal of one rib. The lung was found to be free but the tumour was found to have spread to the periphery of the lung. Pneumonectomy was performed, after ligating the pulmonary artery, pulmonary veins and the bronchus in that order (the bronchus had been previously blocked).

the pleura was stitched over the bronchial stump by suturing it to the edge of the pericardium. The wound and the chest were closed in layers. A drainage tube was inserted.

Following operation, the patient was bronchoscoped.

8.9.48. 6.30 a.m. - Peripheral vascular collapse was found and profound shock, for which there was no apparent reason. A blood transfusion was given as was coramine. He was conscious and mentally clear. There was no clinical sign of haemorrhage. X-ray showed no fluid accumulation in his left chest.

4.30 p.m. - He died.

17.9.48. Pathological Report, Mr. K. Fraser. "The specimen was cut in serial sections by a ham slicing machine in the hope that accurate information might be obtained as to the exact point of origin of the tumour. The result was disappointing as the variation from one "slice" to the next was very slight. The tumour is 7.5 x 7 cm. in diameter and occupies the apex of the lower lobe of the left lung. It has blocked the bronchus to the apex of the lower lobe 2.5 cm. from the point of origin of the bronchus. The tumour has a typical gorgonzola cheese appearance. The posterior and middle divisions of the lower lobe bronchus have been

displaced downwards by the tumour. Several lymph glands encircling the lower lobe bronchus appear to be invaded.

The histological picture is that of a glandular type of carcinoma. Many well formed acini are seen, these are lined by low columnar cells and are filled by mucin. The hilar glands are invaded by similar tumour tissue".

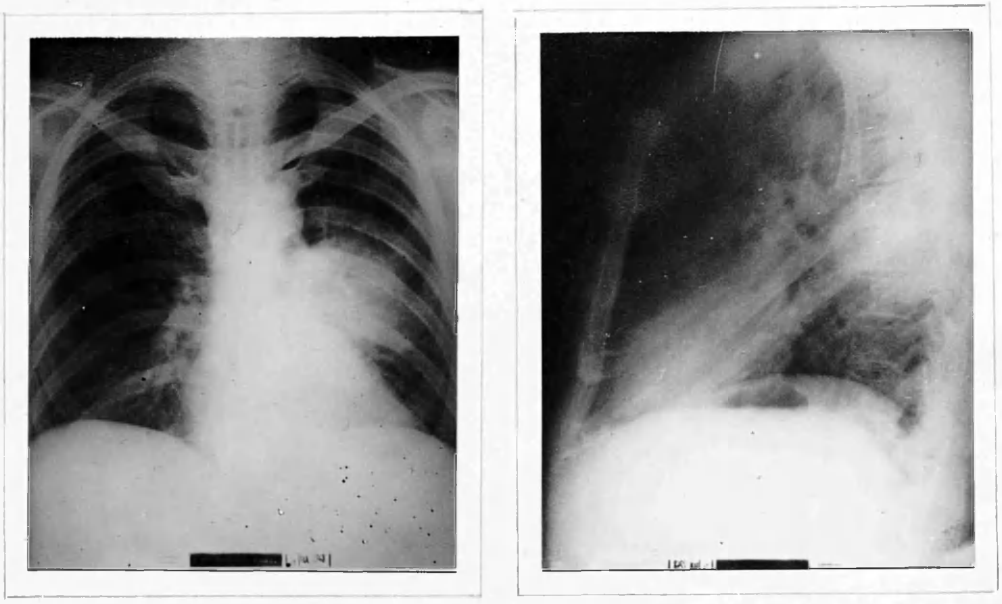


Fig. No. 165. The shadow of the tumour is well seen in the apical segment of the left lower lobe. The lateral photograph confirms the site of the tumour and reveals that it is not directly related to the hilum - it is posterior to the stem bronchus.

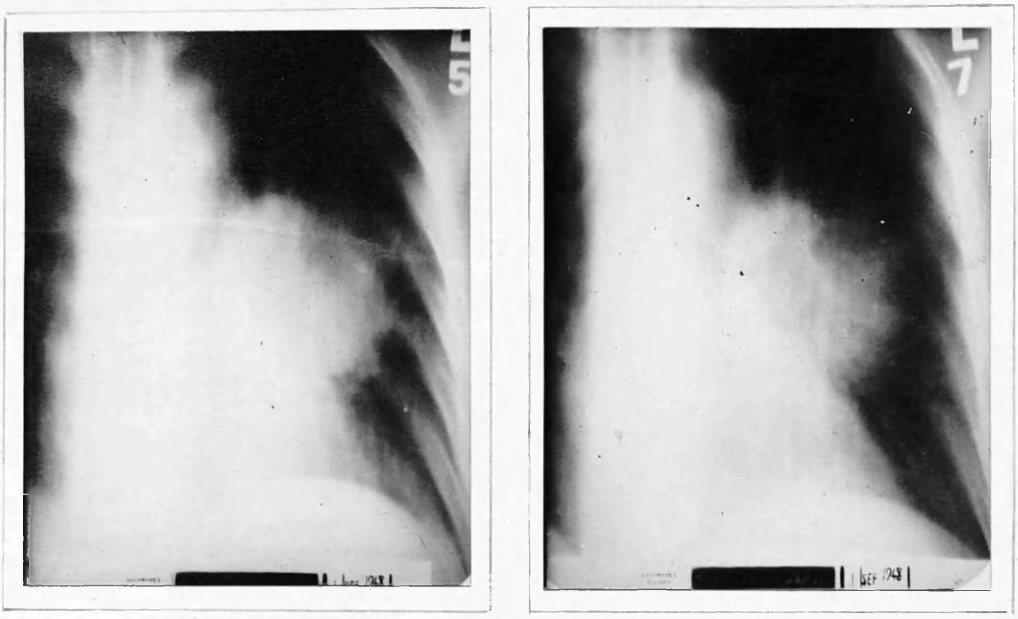


Fig. No.166. Tomographs taken at 5, 7 and 11 cm. from the back confirm that the tumour is posteriorly placed by being best seen at 5 cm.

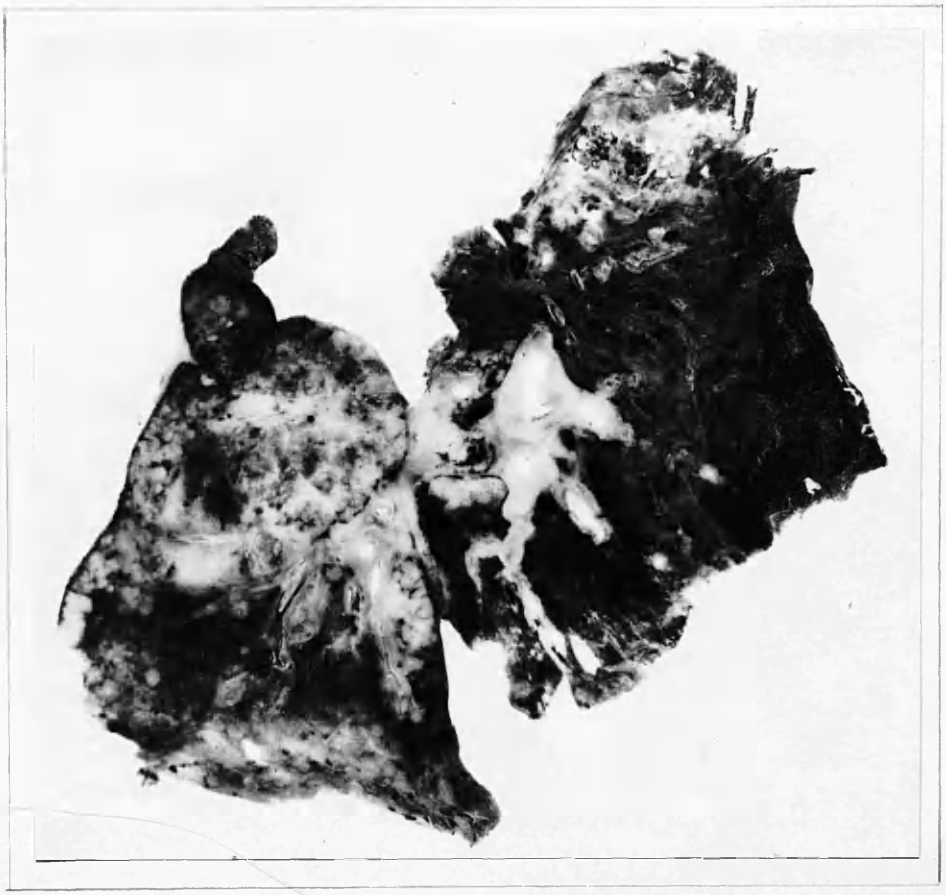


Fig. No.167. This specimen was cut in serial section by a ham slicing machine. This "slice" consists of the apex of the lower lobe held to a segment of the upper lobe by the stem bronchus. The tumour surrounds and has blocked the bronchus to the apex of the lower lobe; it occupies two-thirds of the area of lower lobe seen in the specimen. The greyish white appearance at the top of the fragment of upper lobe is simply due to the "slice" being very thin at this area and it is not due to tumour.

Fig. No. 168. This photograph is taken several "slices" deeper than Fig. No.167. While the tumour in the apex of the lobe is well seen its close relationship to the segmental bronchus is now less obvious.

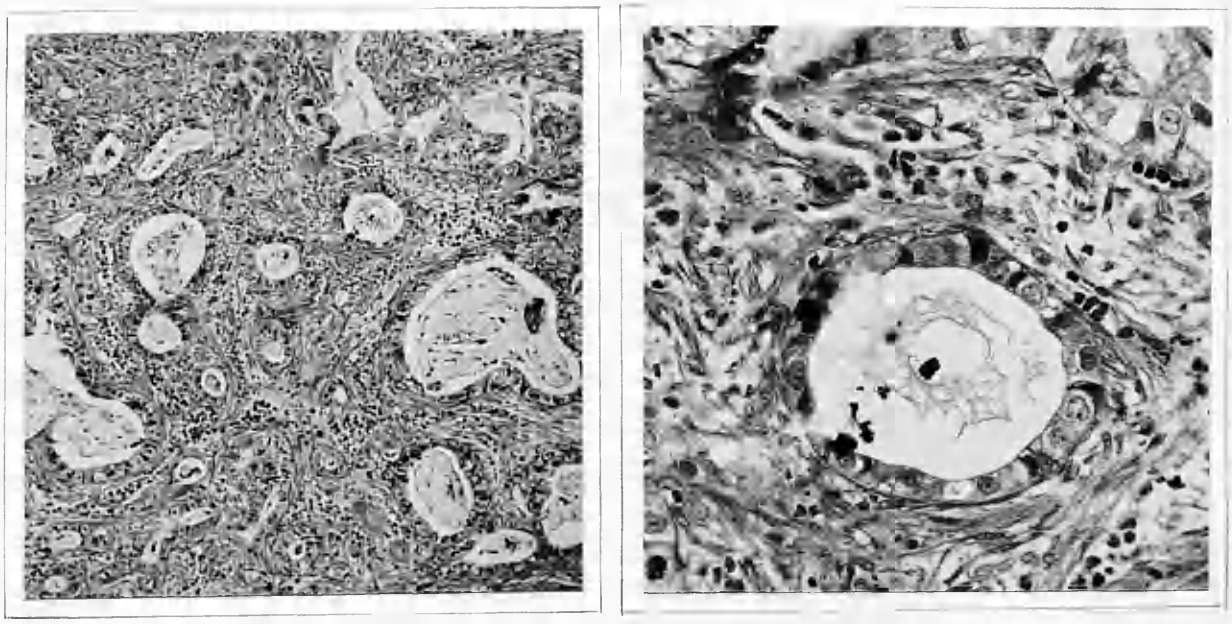


Fig. No. 169. The tumour is of glandular type. Many acini are present and there is considerable mucin formation.

Case No. 51.

J.M. (52), Occupation - Accountant.

Admitted 19.10.49,

Died 14. 5.50.

Diagnosis. Bronchial Carcinoma.

History. In November 1948 she became aware of discomfort and swelling in her feet and ankles towards the end of the day. It was not present in the morning. After a few weeks the swelling extended on to her legs, and at the beginning of the year she noticed difficulty in rising to her feet from a sitting position because of stiffness and swelling of her knees. In May she had to stop work because the disability began to involve her hands, wrists and elbows. At the beginning of the year she had noticed swelling of the ends of her fingers and this had become gradually more pronounced; ten days prior to admission she noticed a soft localised swelling behind her left knee. About the same time as the onset of her joint symptoms she noticed she had bronchial catarrh and consulted her doctor about this. For six months she had had a stuffiness of her head with a tenacious post-nasal discharge for which her sinuses had been x-rayed. Her sputum had been slight. She had not been breathless but she had felt unusually

tired in the last few months prior to admission. There had been no haemoptysis and she had had no pain in her chest. Five weeks prior to admission she had been in Dumfries Royal Infirmary.

Previous health. She had an operation for uterine prolapse in 1932: No other serious illnesses.

Examination. She was a pallid woman who had obviously lost a considerable amount of weight. The hands were soft and flabby and the finger ends were bulbous. There was an undue degree of extension at the metacarpo-phalangeal and interphalangeal joints. The wrists were swollen but the range of movement was not impaired. The elbows were normal. Feet, ankles and knees were moderately swollen. The toes were bulbous. The extremities were warm. Arterial pulsation in the dorsalis pedis and posterior tibial arteries was satisfactory. There was no appreciable effusion into the knee joints. Movements at the shoulder, hip and tempero-mandibular joints were normal. The grip of the hands was poor.

Respiratory system. There was slightly diminished movement on the right side of the chest, which was impaired to percussion in its lower half. Respiratory murmur over the lateral area was appreciably diminished.

The vocal resonance was within normal limits and no adventitiae were heard.

Alimentary system, central nervous system, genito-urinary system showed no abnormality.

There were numerous small discrete and mobile lymph glands palpable in the right axilla and a few in the left.

20.10.49. X-ray Report, Dr. McKail. "There is an ovoid opacity about 12.5 x 11 cm. in the upper part of the lower lobe of the right lung. Its margins were smooth and fairly sharply defined. It is of homogenous density.

Both lower limbs from the knee downwards, both upper limbs from the elbow downwards - Periosteal new bone of the type characteristic of hypertrophic pulmonary osteo-arthropathy is seen in all the areas mentioned.

The mass in the right lung is most probably a slow growing bronchial carcinoma, or less probably a benign condition".

21.10.49. She was allowed up and encouraged to walk about.

23.10.49. Blood sedimentation rate 64 mm. in one hour. Haemoglobin 64%. Red cells 3,900,000. White cells 7,500. Serum calcium, acid and alkaline

phosphates were within normal limits.

1.11.49. She was put on to parathormone 1/2 c.c. intramuscularly and this was repeated daily. It had the effect of producing a febrile response and the ankles and knee discomfort became more marked.

15.11.49. Parathormone was discontinued.

16.11.49. X-ray Report, Dr. McKail. "Straight x-ray and intravenous pyelogram show normally functioning kidneys".

14.11.49. X-ray Report, Dr. McKail. "Compared with films of 20.10.49 the mass has increased in size. The tumour is almost certainly a bronchial carcinoma".

21.11.49. She was put on to a 4 day course of nitrogen mustard 4.5 mgms. per day and this produced nausea and anorexia.

5.12.49. She had complained of a salty taste in her mouth since the course of nitrogen mustard and also of looseness of her bowels. Examination showed no swelling of knees or ankles and a full range of movement. Finger clubbing was still present but not painful. Examination of the chest revealed diffuse impairment of percussion of the right chest, especially posteriorly. The breath sounds were diminished. A few rales were heard at the lung root posteriorly.

6.12.49. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Gas, Oxygen,
Cyclopropane.

The right hemithorax was opened by resecting the 5th and 6th ribs but preserving the intervening intercostal. On opening the pleura, the lung was found to be free and no free fluid was present. There was a massive tumour in the lung which was not attached to pleura. The bronchus, pulmonary artery and the pulmonary veins were secured in that order quickly, the vessels were then doubly ligated, doubly transfixed and divided. The bronchus was cut across and the lung was removed. There was only one soft gland present at the hilum and this was removed for histological examination. The bronchus was secured right at the carina, and closed with interrupted silk mattress sutures and a more distal row of single sutures. The intercostal bundle was then sutured over the bronchial stump. The chest was closed after instillation of penicillin and sulphathiazole powder. A self retaining catheter was inserted. Throughout the operation her general condition remained good.

8.12.49. Royal College of Physicians Laboratory,
Dr. McGregor. "1. Hilar gland. 2. Lung tumour.

I. Hilar gland - This is a reactive gland showing no evidence of metastases.

II. Epidermoid carcinoma.

2. The tumour is composed of solid alveolar sheets of epidermoid cells showing some polymorphism. No cells show keratin formation.

3. Numerous mitotic figures.

8.12.49. Patient's general condition is very satisfactory. There was no discomfort in the joints.

12.12.49. General condition remained satisfactory. Drainage tube was removed from the chest.

15.12.49. She was allowed up in a chair.

19.12.49. She developed increased respiratory difficulty. Oxygen was administered. The mediastinum was not displaced but there was a moderate effusion in the right chest. Intrapleural pressure was +6/-1. Air was withdrawn, 500 c.c. was taken out and fluid began to appear. The intrapleural reading had become more positive. Fluid aspirated amounted to 780 c.c. of dark brown colour and there was considerable relief of respiratory embarrassment and improvement in her pulse.

5 p.m. - X-ray showed right hydro-pneumothorax with displacement of the mediastinum to the left. Intrapleural pressure was positive and a further 500 c.c.

of air were withdrawn. The chest felt tight, so 300 c.c. of air were re-introduced and the pressure was zero.

20.12.49. Theatre. Under local anaesthesia a drainage tube was inserted into the right chest posteriorly. Blood stained fluid drained away in quantity. Tube connected to an under-water drainage bottle. There was no evidence of fistula formation.

27.12.49. About midnight she passed into coma with full and frequent pulse on respiration. She recovered quickly from the attack and had no recollection of its occurrence.

30.12.49. Drainage tube was removed.

7.1.50. 125 c.c. of turbid fluid was aspirated from the right chest and air withdrawn. Penicillin was instilled. Transfusion of pack cells with 2 pints of blood was given.

16.1.50. Aspiration of 350 c.c. of light greenish fluid very slightly turbid was removed from the chest with air. Culture of this fluid showed a few colonies of bacillus coli.

In February a mass began to re-appear in the right chest. This gradually increased in size and soon became obvious as a tumour secondary. Her condition

slowly deteriorated and she died on 14.5.50.

Pathological Report, Mr. K. Fraser. "There is a massive white tumour 12 x 7.5 cm. in size, lying in the apex of the lower lobe and centred on the line of the bronchus to the apex of the lower lobe. No obvious connection between the tumour and the bronchus to the apex of the lower lobe could be found. The tumour would appear to be of peripheral type. The centre of the tumour over an area of 5.5 x 4.5 cm. shows complete necrosis. There is no evidence of gland invasion to the naked eye. The lung is pushed aside by the tumour, this gives the effect of a capsule to the tumour".

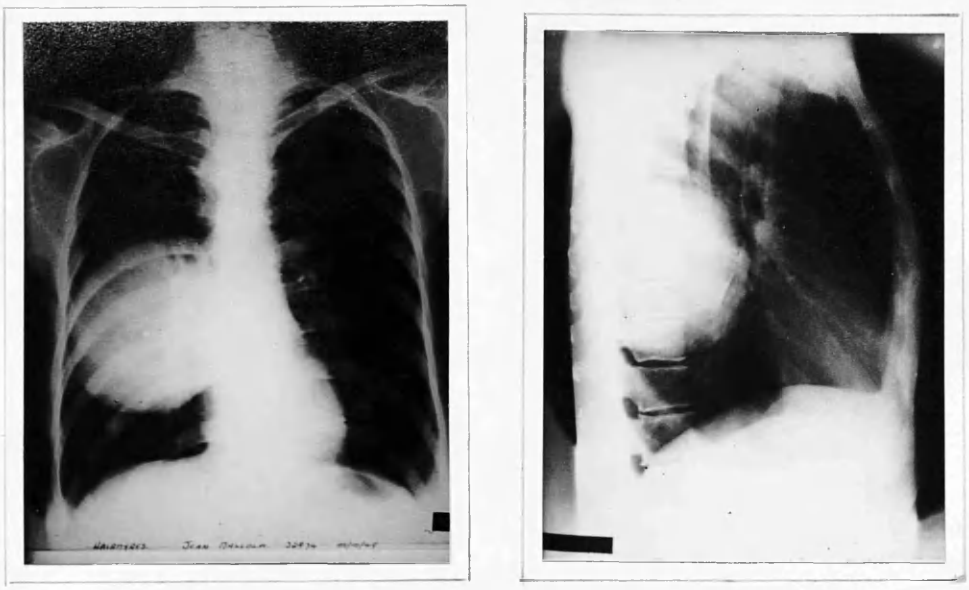


Fig. No. 170. The X-ray films reveal that the tumour is of large size. The value in localisation of the tumour by lateral X-ray films is exemplified; the tumour is seen to be in the apex of the lower lobe.

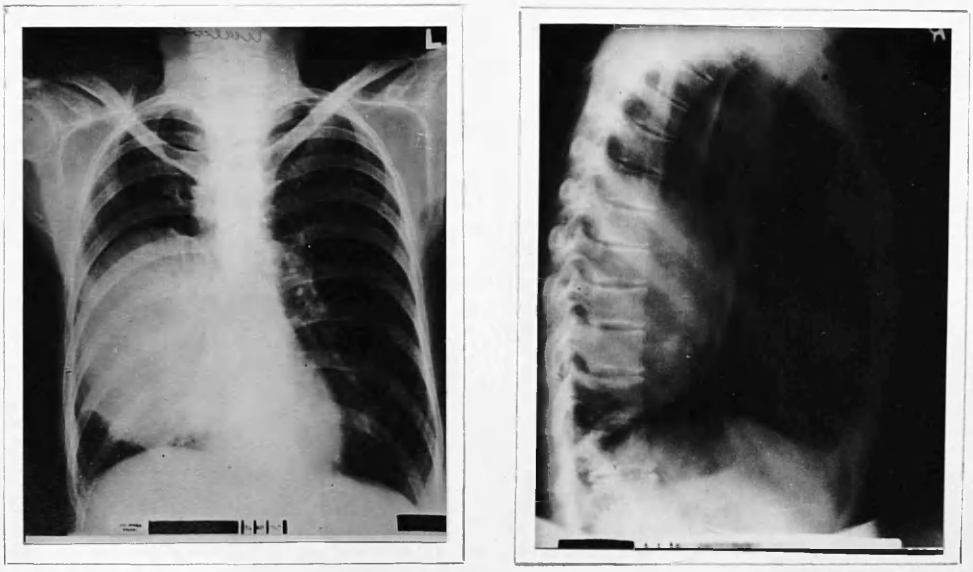


Fig. No. 171. The photograph on the left shows the increase in size after three and a half weeks, the one on the right after a further five weeks.

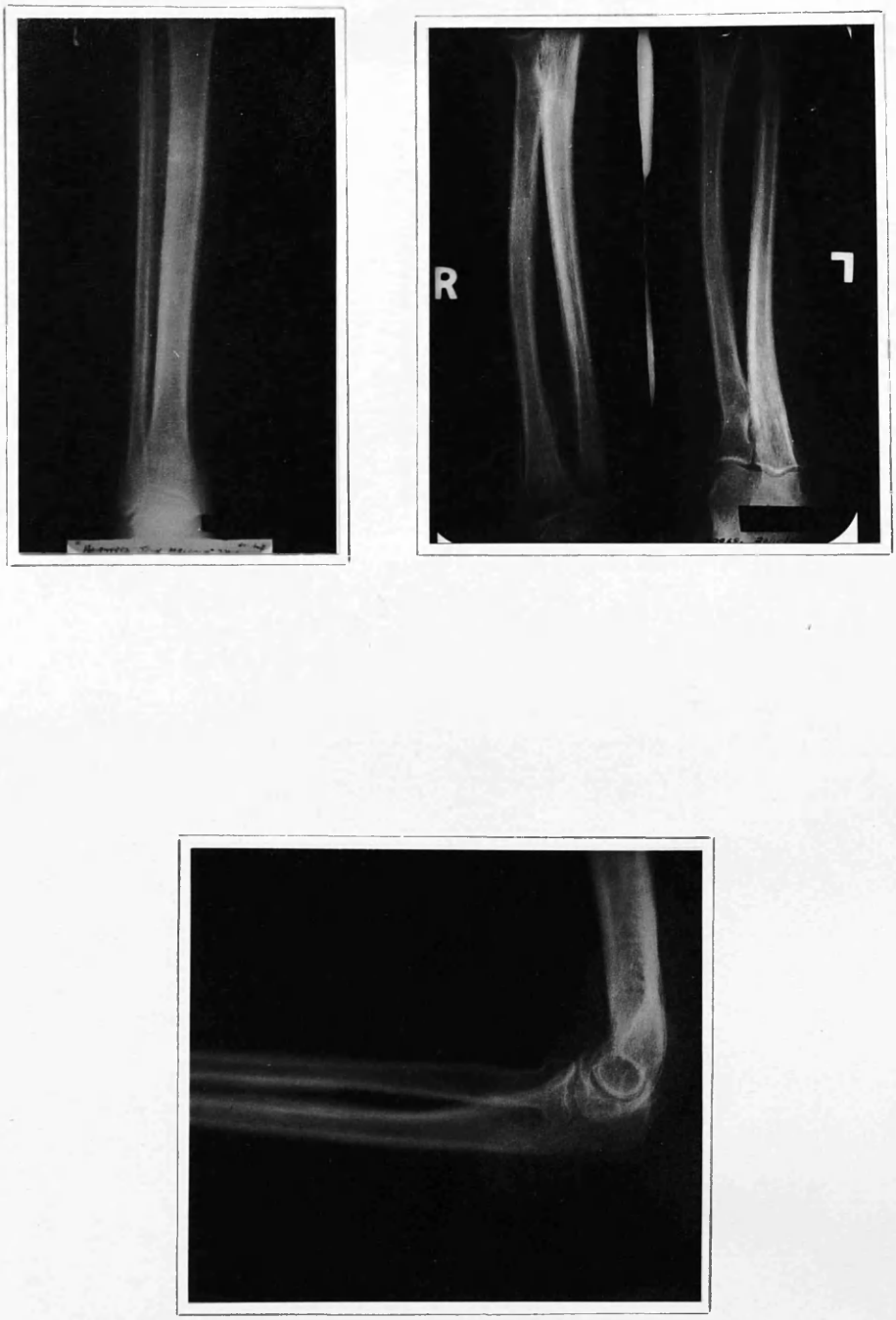


Fig. No.172. X-ray films of some of the long bones which show well marked periosteal new bone formation. This was one of the cases of hypertrophic pulomnary osteo-arthropathy associated with bronchial carcinoma.

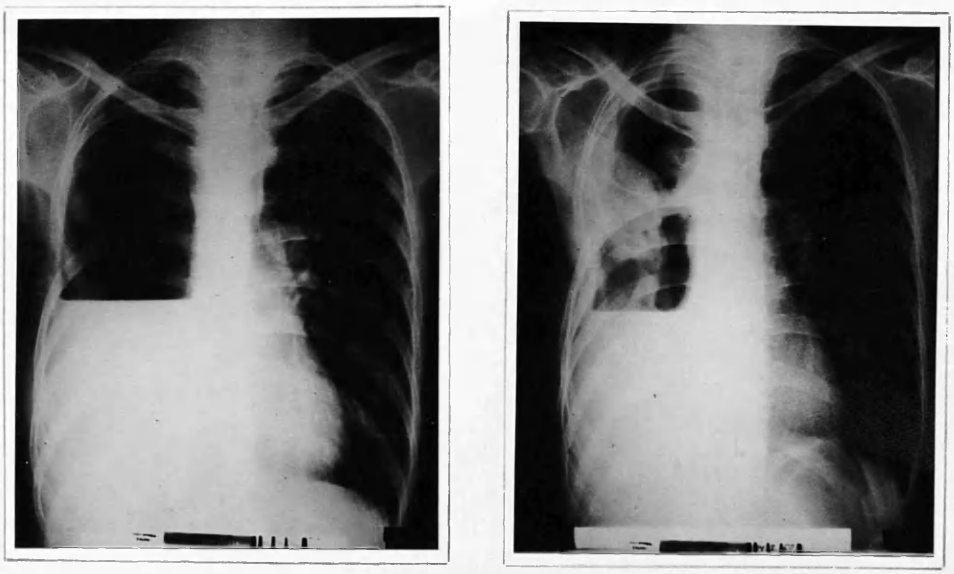


Fig. No. 173. X-ray films taken at six and ten weeks after pneumonectomy. The picture at six weeks shows a small shadow on the lateral chest wall possibly due to tumour secondary, the one at ten weeks confirms that it is a secondary which is increasing rapidly in size.

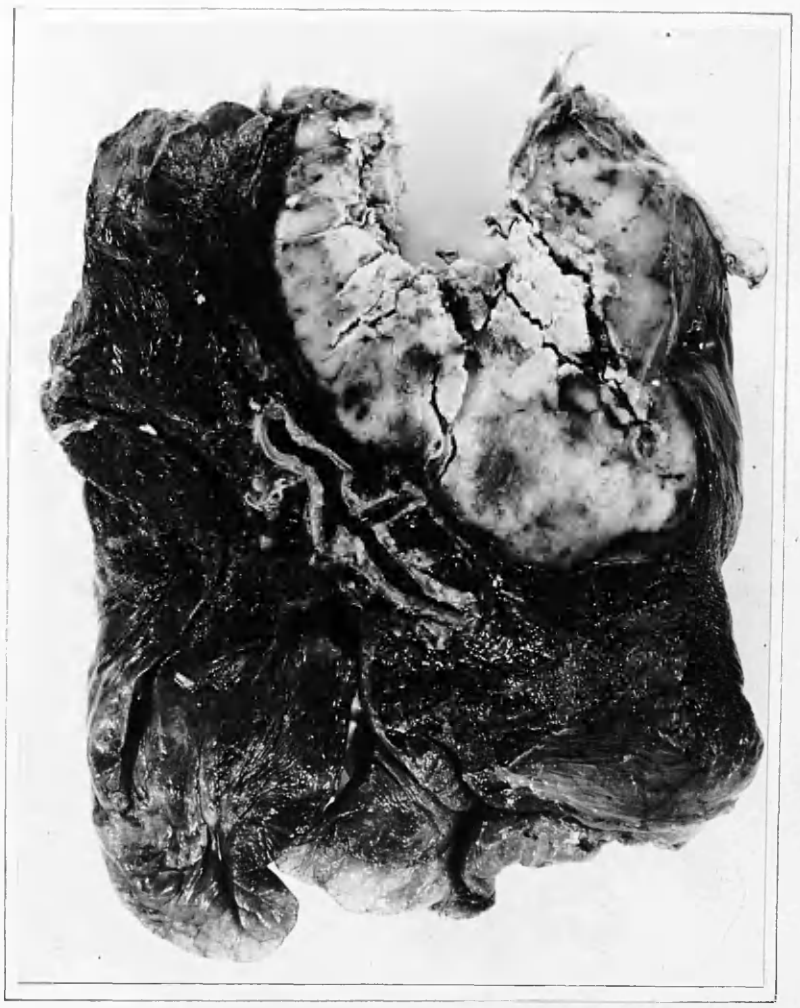


Fig. No. 174. Section of the lung shows the tumour directly opposite the bronchus to the apex of the lower lobe. The commencement of the middle lobe bronchus can be seen directly opposite this bronchus. No connection could be found between the tumour and the apical segment bronchus. The lung tissue has been pushed aside and compressed by the tumour giving the appearance of a false capsule.

Fig. No.175. The tumour in the apex of the lower lobe was 12 x 7.5 cm. There is extensive central degeneration.

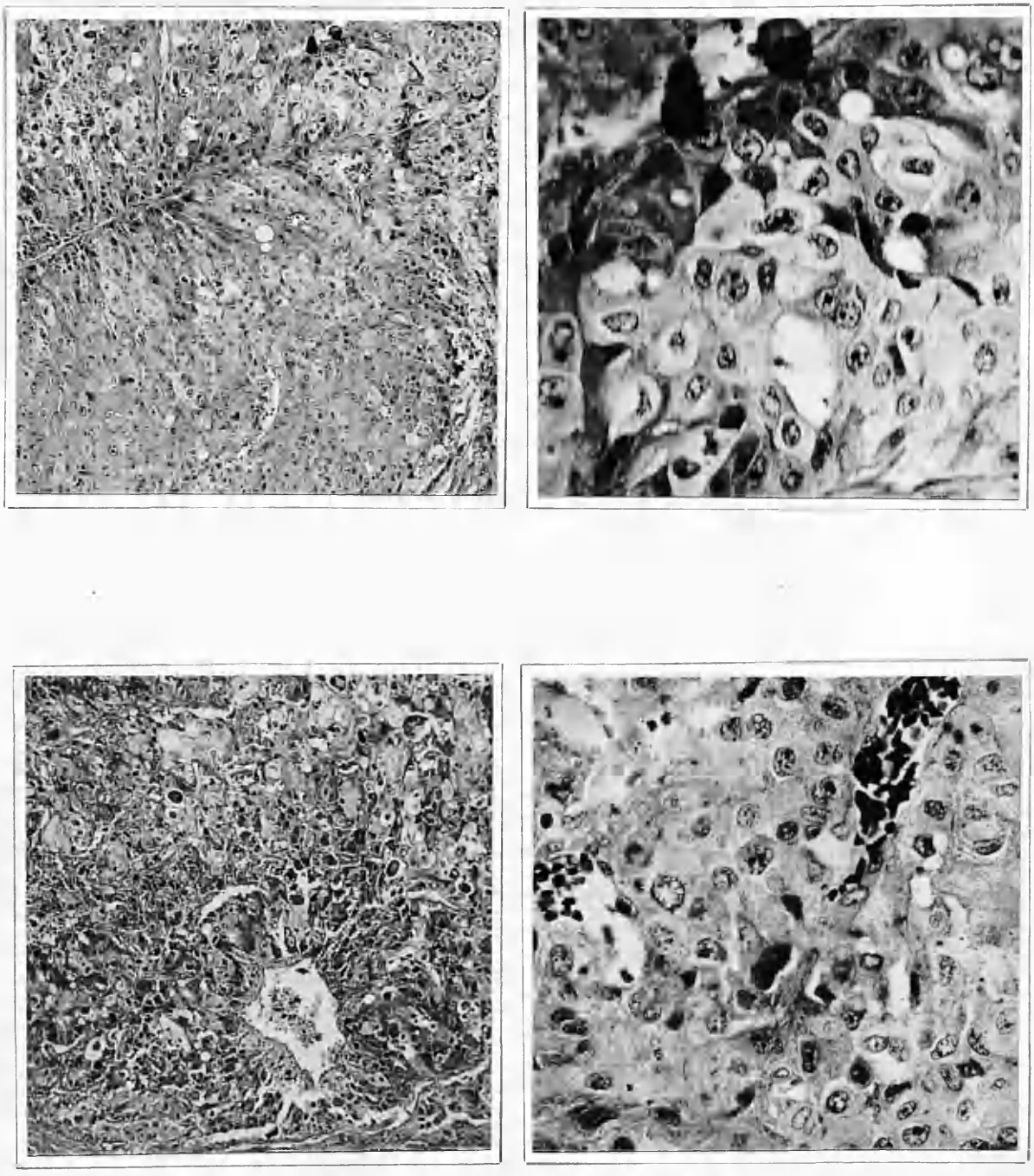


Fig. No.176. The tumour consists of solid sheets of epidermoid cells. There is considerable mucin formation.

Case No. 52.

M.M. (50). Occupation - Waitress.

Admitted 12.10.43.

Dismissed 11.2.44.

Diagnosis Bronchogenic carcinoma of left lower lobe.

History. She had been in good health until four months prior to admission when she developed a troublesome persistent cough which produced frothy sputum. This cough frequently came in paroxysms, which made her sick. As a result, she lost her appetite, and frequently vomited. After a short time the sputum became more tenacious, and it had remained so until admission. A week prior to admission she had had a small haemoptysis. She commenced to lose weight and strength, and this had gradually progressed. She was x-rayed six weeks previously and was admitted to Glasgow Royal Infirmary four weeks later. She had never had any pain in her chest, nor shortness of breath. For about one month she had had a pain in the lumbar region of a gnawing nature. There had been no upset of micturition; her bowels had been constipated. The menopause had occurred four years previously.

Previous health. No past illnesses were mentioned. The W.R. was positive.

Examination. She showed a picture of recent loss of weight, and her general condition was only fair. There was no oedema, cyanosis, or jaundice. She had a marked degree of clubbing of the fingers. She was not dyspnoeic at rest.

Respiratory system. There was dullness over the left half of the chest, both anteriorly and posteriorly. Respiratory murmur was reduced, as was the V.F. and V.R. There was no bronchial breathing and no adventitiae.

Cardio-vascular system showed no abnormality. Blood pressure 110/75.

Alimentary system. No masses were palpable and the kidneys could not be felt.

Central Nervous system . No abnormality.

Genito-urinary system. No abnormality.

13.10.43. X-ray Report, Dr. McKail. "There is a large rounded mass in the left lower lobe, extending to the ribs posteriorly and laterally, and probably also into the costo-phrenic angle posteriorly. Appearances suggest an alveolar type of neoplasm. Other appearances normal".

14.10.43. She was allowed up and various measures were instituted to increase her muscle tone.

20.10.43. She showed a general all round improvement.

24.10.43. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Cyclopropane.

Left postero-lateral incision. The chest was opened through the 7th interspace; the tumour at once presented itself in the lower aspect of the pleural cavity. It was adherent to the thoracic cage and diaphragm and was at first thought to be inoperable, but the adhesions were freed by blunt dissection. The lung was then removed after individual dissection, ligation and division of the hilar structures. A pack was inserted through a stab incision in the scapular line. Wound was closed. Operative time 60 minutes.

During the operation a blood transfusion was in progress and continued afterwards to a total intake of 3 pints of blood and two pints of plasma.

Pathology Report - Mr. Fraser.

"When the lung was cut a tumour 10 cms. in diameter was found to lie in the lower lobe, which it almost completely replaced, and a rim of which it had pushed to the side. The lingula was free from the

tumour. The cut surface was white and studded by greenish areas like gorgonzola cheese. The central area showed complete necrosis but no recent haemorrhages. No lymph node spread was noted".

Histological Report, Mr. Fraser.

"The alveoli were filled with cells, some of which were pale cells and others were smaller and stained more deeply. The picture was that of an encephaloid carcinoma, and numerous mitotic figures were seen. Some of the cells were arranged in columns.

The histology was kindly seen by the late Professor Shaw Dunn who stated that it might be a primary alveolar carcinoma, although a secondary from any epithelial tissue - particularly the kidney - could not be excluded. Post mortem alone would tell. With this opinion Dr. Lendrum agreed".

25.10.43. The pack was removed. She was very well.

27.10.43. She was very well indeed.

3.11.43. 2,000 c.c. of sero-sanguinous fluid were aspirated. She ultimately developed an empyema and required the insertion of a drainage tube, which was carried out on 17.11.43.

5.1.44. She had an intravenous pyelogram which

showed no evidence of hypernephroma.

6.1.44. Operation - Mr. Fraser. Left phrenic nerve crush.

4.2.44. She was found to have a broncho-pleural fistula.

9.2.44. Patient died at 1 p.m. Secondaries were found in the opposite lung. The kidneys, liver and adrenals were apparently normal. 1½" x 1" mediastinal tumour was found encroaching into the left pleura.

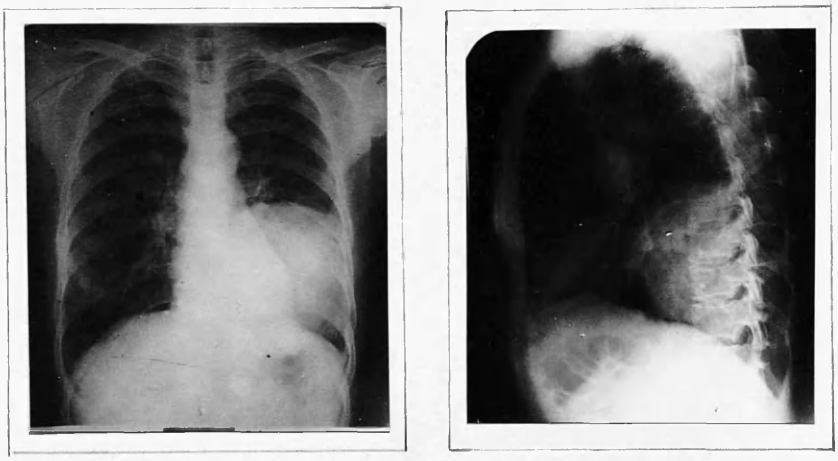


Fig. No. 177. The large spherical tumour is seen in the left lower lobe. The postero-anterior view suggests that the tumour occupies the entire lower lobe but the lateral photograph shows that the apical and anterior divisions of the lower lobe are probably free, though the elevation of the anterior half of diaphragm would indicated that the anterior segment is collapsed.

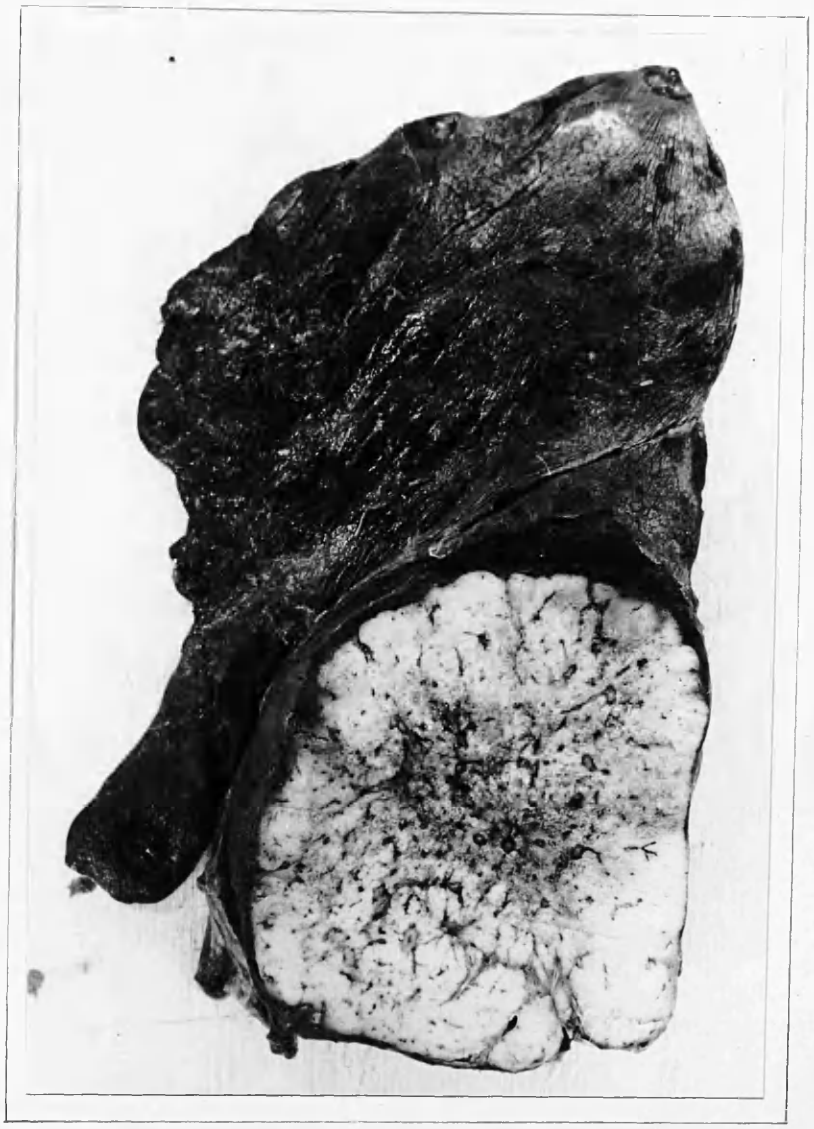
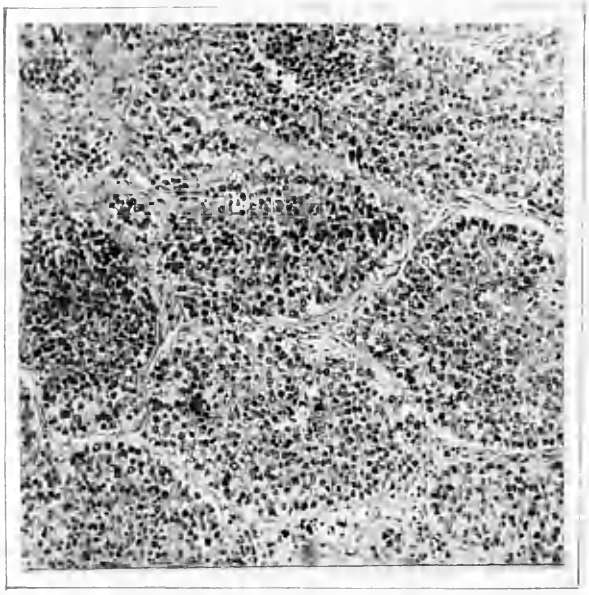


Fig. No. 178. The lower lobe has been cut across. Except in the apical and anterior segments the lobe is completely replaced by a tumour 10 cm. in diameter. The centre of the tumour is necrotic.



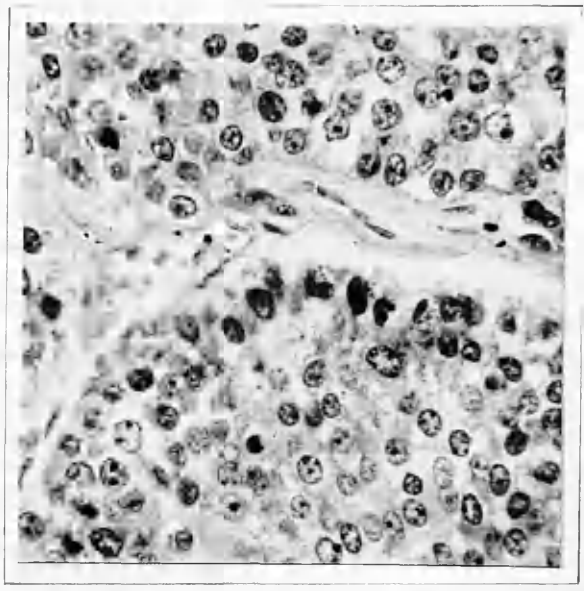


Fig. No. 179. The cells are arranged in masses, which give the appearance of "solid alveoli". The cells vary in size; they have rounded nuclei with usually two or more nucleoli. Mitoses are fairly numerous. Many of the cells towards the centre of the "solid alveoli" are necrotic.

Case No. 53.

W.G. (47). Occupation - Miner.

Admitted 21.6.49,

Dismissed 6.8.49.

Diagnosis Bronchial carcinoma of right lower lobe.

History. Four months prior to admission he was perfectly well, when he felt a sudden pain in his back, about the lower dorsal and upper lumbar regions, while he was struggling with a hutch at the coal face. This pain had persisted and was now passing down both legs. About this time he began to have a productive cough which produced sputum which was sometimes stained with blood. He had been losing weight and was lacking in energy.

Examination. On admission to the Orthopaedic Wards at Hairmyres, he was found to be a middle aged man who did not appear to be acutely ill. There was evidence of loss of weight. There was no jaundice, cyanosis or oedema but there was a slight degree of clubbing of the fingers. Examination of his spine revealed diffuse tenderness over the middle and upper parts of the lumbar spine. Movements of the lumbar spine were restricted and there was a tendency to keep his back immobile. Movements of the hip were restricted, especially flexion.

Respiratory system. There was decreased movement of the right side of the chest with impaired percussion at the right base and diminished breath sounds over the lower half of the right lung and there were no accompaniments.

21.6.49. X-ray Report, Dr. McKail. "There is generalised osteo-arthritis of the dorsal and lumbar spine, sacro-iliac and hip joints, but no evidence of primary or secondary malignancy.

There is a large spherical opacity in the right lower lobe, the appearance of which suggests a simple cyst, possibly hydatid. Screening should be carried out to investigate the presence, or otherwise, of change of contour of the mass with respiration".

27.6.49. X-ray Report, Dr. McKail. "Changes typical of hypertrophic pulmonary osteoarthropathy are present in the wrists, forearms and knees. The appearances in the chest are characteristic of neoplasm, probably a primary bronchial carcinoma".

29.6.49. He was transferred to Ward 4.

6.7.49. Operation - Mr. Dick, Mr. Fraser.
Dr. Pinkerton -
Pentothal,
Cyclopropane.

The right chest was opened by the usual postero-

lateral incision and the pleura was opened through the bed of the 7th rib. The lung was lying free, apart from some adhesions between the lower lobe and the diaphragm. The tumour consisted of a tense solid mass 4" in diameter, which occupied the whole of the lower lobe. The right main bronchus was isolated, clamped and divided. The pulmonary veins and then the pulmonary artery were secured in turn, ligated and divided. A small gland, firm in consistency, was found in the hilum and this was removed. The bronchus was closed immediately below the carina by a series of mattress sutures and a more distal continuous suture.

Penicillin-sulphathiazole powder was applied to the stump and the phrenic nerve was crushed; a de pezzer catheter was inserted posteriorly and the chest was closed after the instillation of 50,000 units of penicillin.

During the operation, he had a transfusion of whole blood and 0.1% procaine.

6.7.49. On the first day following the operation he found that he was able to move his knees and ankles more freely. His general condition was very good.

8.7.49. His drainage tube was removed.

10.7.49. His joints were satisfactory. His

condition was good.

Pathological Report, Mr. K. Fraser. "The whole of the lower lobe is almost completely replaced by a greyish white tumour which is almost circular and measures $8\frac{1}{2}$ x 9 cm. in diameter. There is here and there some greenish stippling from remaining lung tissue. The tumour reaches to within a third of a centimetre of the lower border of the lower lobe. Over this surface the pleura is thickened to several millimetres in diameter. The lung tissue surrounding the tumour is tightly compressed, to give the appearance of a false capsule around the tumour. There are several black, pigmented glands around the main bronchus".

Royal College of Physicians, Histological Report, Dr. Lees. "There is much necrosis and here and there some necrotic neoplasm. This consists of masses of largish malignant cells. The tissue is unfortunately too necrotic to be sure that it is a carcinoma but that is very probable, and also that it is a bronchogenic carcinoma. The lymph node is not invaded.

Further sections were taken. These consist of masses of largish malignant cells epithelially arranged in places but otherwise quite undifferentiated. There are numerous mitotic figures.

One can sum this up as an undifferentiated carcinoma conformable with a bronchogenic carcinoma and without distinctive characters to definitely suggest any other origin".

6.8.49. He had made a good recovery and was discharged from hospital.

18.8.49. He reported as an outpatient and was walking in rather a bent position. His right shoulder was stiff. The general condition was fair.

11.10.49. It was reported that he had died.

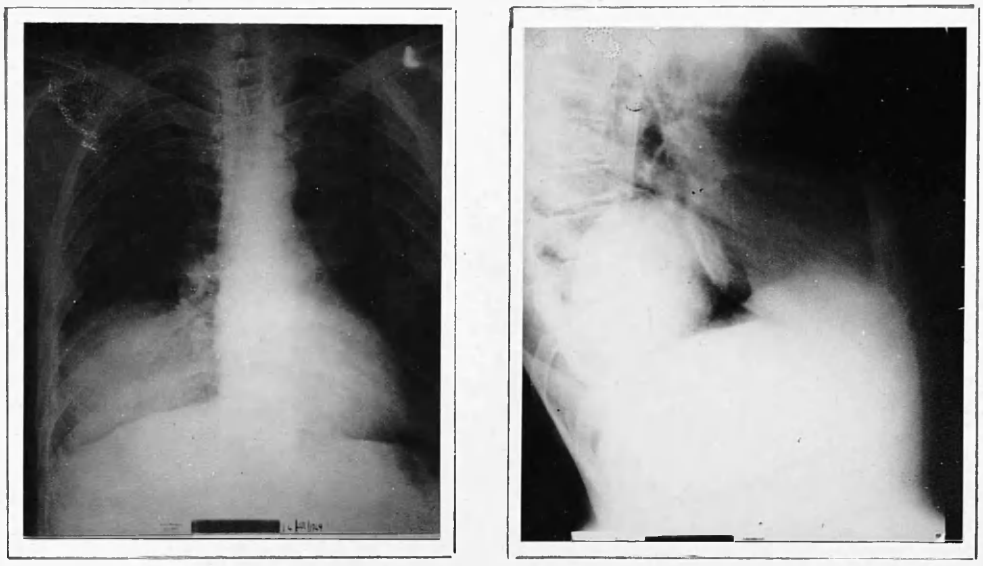


Fig. No.180. The tumour casts a large spherical shadow which almost completely fills the area of the right lower lobe. The heart has been pushed towards the left by the bulk of the tumour.

Fig. No. 181. The specimen is the whole right lung. The lung has been cut to reveal the tumour as it replaces almost completely the lower lobe. It measures 9 x 8.5 cm. The tightly compressed lung tissue gives the appearance of a "false" capsule.

Case No. 54.

M.McN. (39), Occupation - Riveter.

Admitted 19.5.47,

Dismissed 19.5.47.

Diagnosis Bronchial carcinoma.

History. Three months prior to admission he had an attack of influenza with cough and spit. Two weeks later he developed a severe pain in the right chest. This pain was still present on admission and was worse on deep breathing. During the attack of influenza he lost 2 stone in weight. He was admitted to Larkfield Hospital on 22nd February. He had had a harsh unproductive cough but no haemoptysis.

Examination. He was a pale, thin man. There was no cyanosis or dyspnoea but there was slight clubbing of the fingers.

Respiratory system. Movement over the lower part of the right chest was diminished. At the right base anteriorly and posteriorly the percussion note was dull and numerous crepitations and rhonchi were heard just above this area. In this area the respiratory murmur was also diminished.

At this time X-ray showed a complete collapse of the right lower lobe and a bronchogram showed a complete

blockage of the main bronchus to the right lower lobe just below its junction with the trachea.

2.4.47. Bronchoscopy, Dr. Semple. "The trachea and carina are normal. The right upper and middle lobe orifices are normal. At the distal end of the right lower lobe bronchus obstructing distal orifices is seen fleshy tumour tissue - much purulent discharge is coming from this area. A biopsy was taken".

3.4.47. He coughed up a lot of sputum after the bronchoscopy and felt much improved.

9.4.47. A right artificial pneumothorax was induced. X-ray showed complete clearing of the lung from the costo-phrenic angle and the diaphragm. He had some embarrassment with his pneumothorax and some air required to be removed.

10.4.47. Operation - Mr. Dick, Mr. Fraser.
Dr. Pinkerton -
Cyclopropane,
Tubarin.

The chest was opened through the usual right postero-lateral incision and through the bed of the 6th interspace. The lung was found to be free apart from a few inflammatory adhesions between the lower lobe and the diaphragm. The hilar structures were dissected out and isolated with difficulty owing to the shortness

of the vessels and the main bronchus. One mediastinal gland was discovered and removed. The bronchus and the vessels were ligated and divided individually. Bronchial stump was covered with a flap of pleura. A self retaining catheter was inserted in the 2nd interspace anteriorly and the wound was closed.

12.4.47. The chest was aspirated and 350 c.c. of blood stained fluid was removed, in addition to a pint of fluid which had escaped through the catheter.

20.4.47. Pathological Report, Mr. K. Fraser.

"There is a greyish white tumour 3 x 3.5 cm. in diameter in the apex of the lower lobe of the right lung. The tumour has grown in a proximal direction into the stem bronchus where it can be seen as a papillomatous projection 3 cm. high. The papillomatous projection has blocked the middle lobe bronchus by projecting 2 cm. proximal to its orifice. The apex of this projecting tumour tissue shows some small areas of haemorrhage. The lower lobe bronchi show marked bronchiectatic changes and several small abscesses. The lingula shows atelectasis and consolidation.

The histological sections show a moderately well

differentiated squamous epithelioma. Mitoses are fairly numerous".

23.4.47. His condition was good and the "leak" tube was removed.

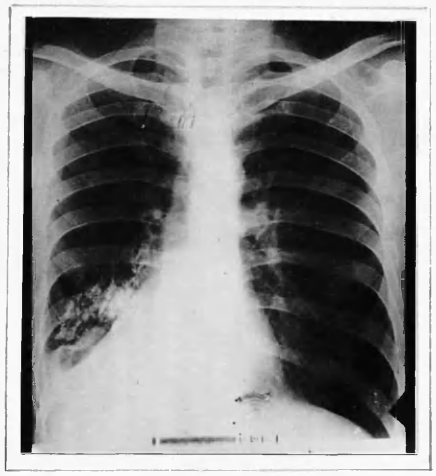
1.5.47. He was allowed up.

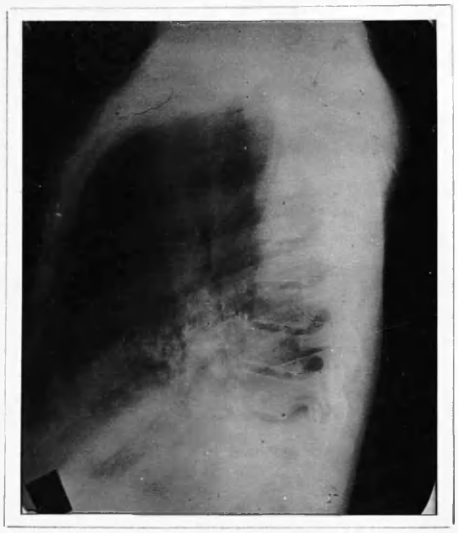
15.5.47. He was well and walking about.

19.5.47. He was discharged home.

20.8.50. A report was received from Mr. Lyall, Larkfield Hospital, Greenock, that the patient was now under treatment for a carcinoma of the prostate.

He died from carcinoma of the prostate in February, 1951.





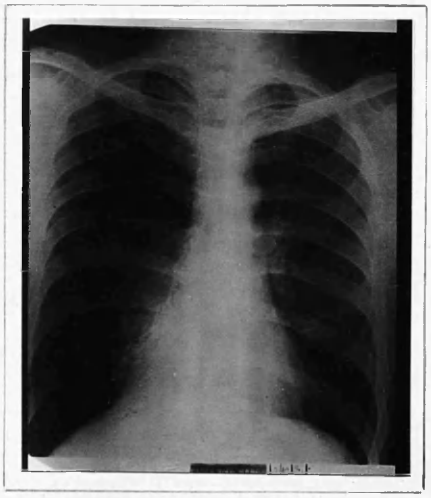


Fig. No. 182. The right lower lobe is collapsed and is represented by the dense triangular shadow seen on the postero-anterior X-ray film. The mediastinum has shifted to the right as evidenced by the superior mediastinal shadow to the right of the sternum and by the relatively small heart shadow to the left. The lower X-ray film shows correction of the displacement phenomenon after induction of an artificial pneumothorax; although it cannot be seen on the photograph the lung "fell away" from the chest wall and showed no adhesion to the chest wall. The "wooly" opacities would appear to be due to old lipiodol.

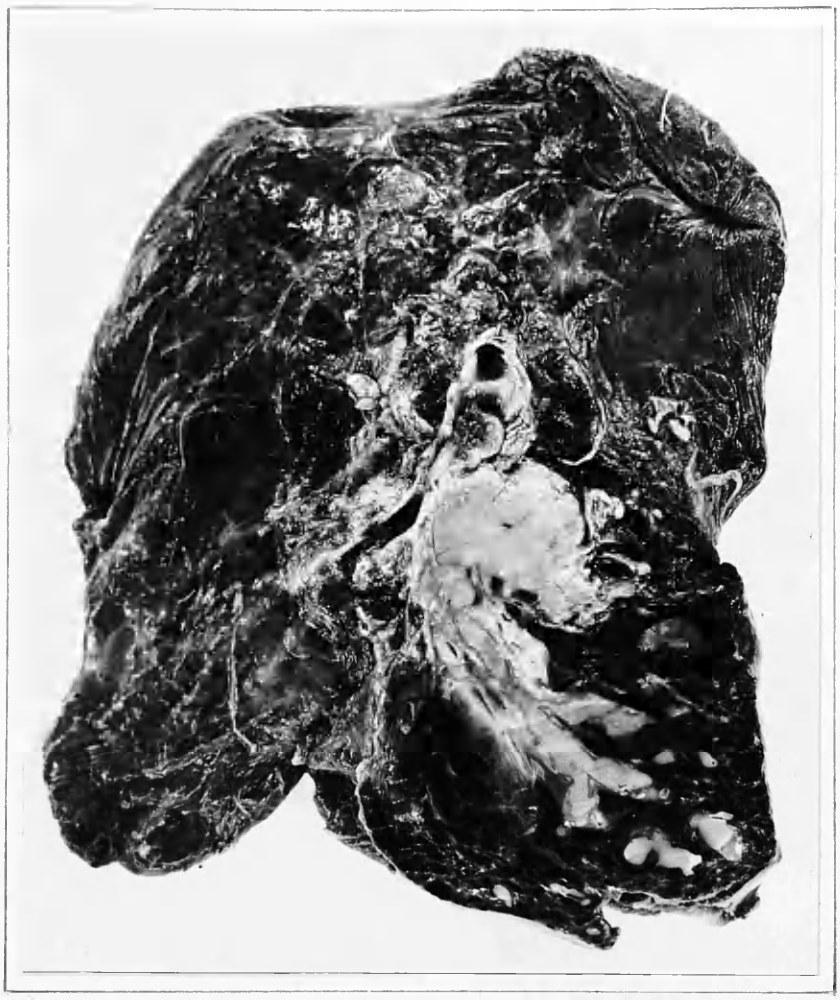


Fig. No. 183. The oval shaped tumour is lying in the apex of the right lower lobe. It measures 3 x 3.5 cm. It has projected into and is extending proximally in the stem bronchus as a tumour polyp. The middle lobe bronchus has been cut open and can be seen running downwards and to the left. Bronchiectatic changes are well seen in the anterior, middle and posterior lower lobe bronchial divisions; a few small abscesses are also visible.

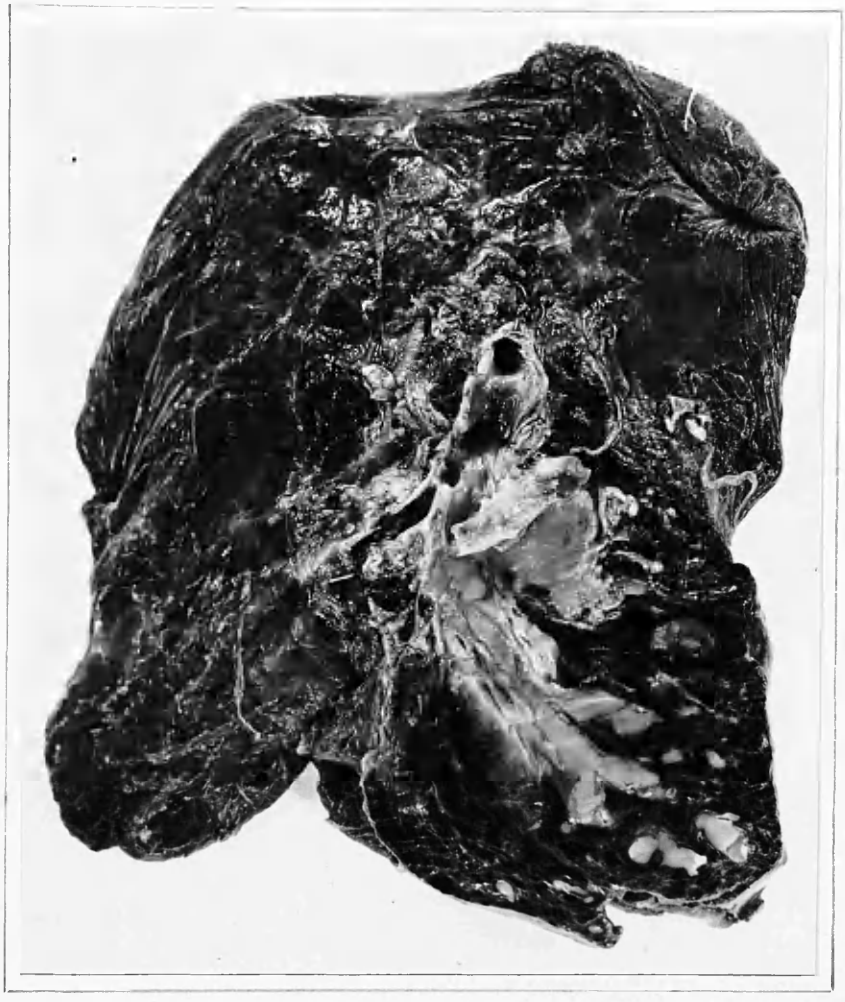


Fig. No. 184. The same tumour as Fig. No.183. The polypoidal projection of the tumour has been turned forwards and downwards to reveal the stem bronchus and the orifice of the middle lobe bronchus.

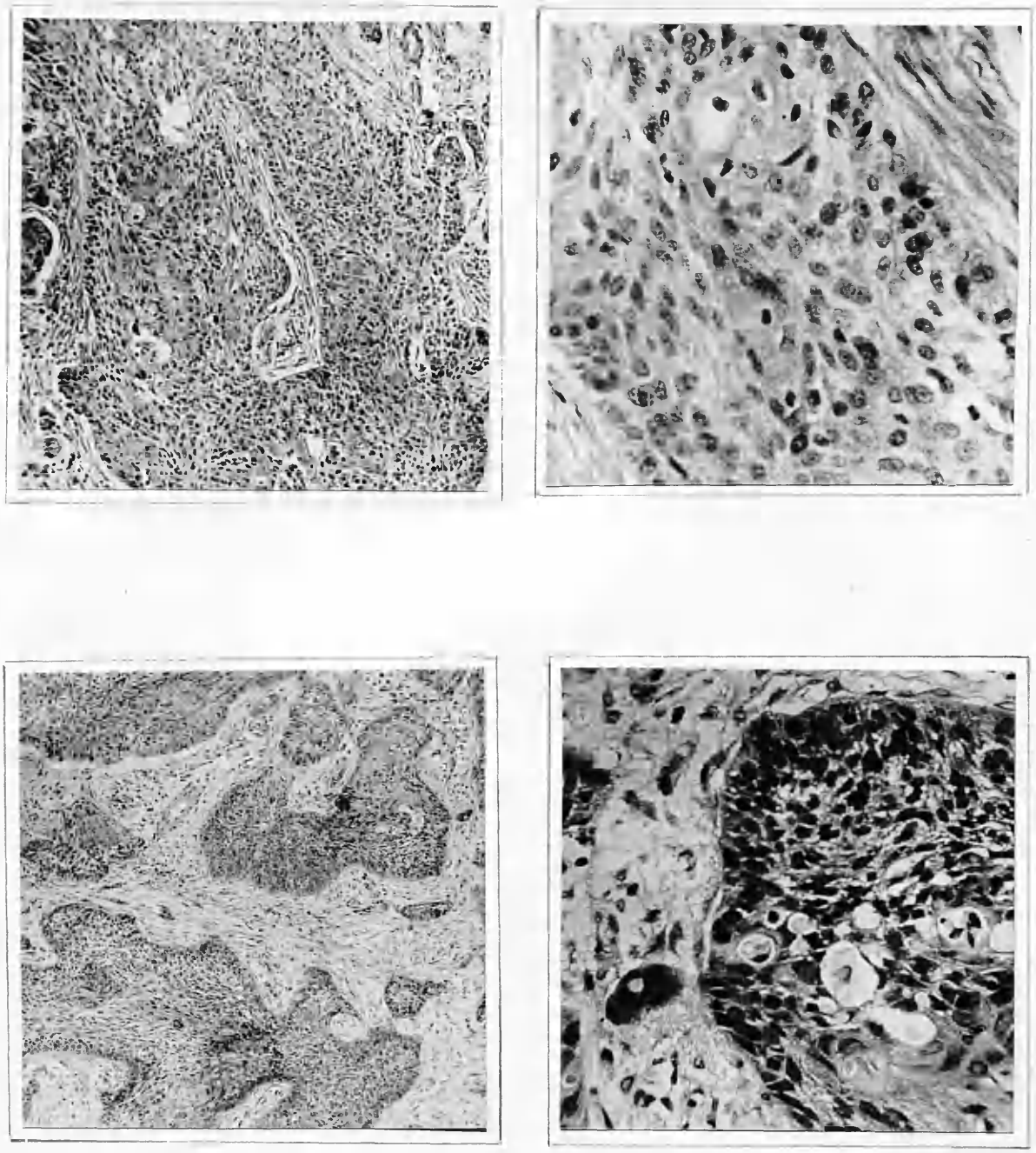


Fig. No.185. A fairly well differentiated squamous epithelioma. Some mitotic figures can be seen.

Case No. 55.

J.P. (47). Occupation - General Practitioner.

Admitted 16.9.47, 26.9.47,

Dismissed 22.9.47. 16.1.48 (Died).

Diagnosis Bronchial Carcinoma.

History. For three months prior to admission he had had blood stained sputum. For two months he had had wheeziness but no actual pain or breathlessness. He had a slight cough. There had been no loss of weight.

Previous health. In 1930 he had a double antral operation for polypi but he still had a post-nasal discharge. Appendicitis when 14 years old.

Examination. He was a small, spare, middle-aged man of sallow complexion in fair general condition.

Respiratory system. At the right base the respiratory murmur was diminished and a few rhonchi were heard; otherwise no abnormality was found.

Cardio-vascular system and Alimentary system showed no abnormality. Blood pressure 112/20. Blood count - Hb. 104: R.B.C. 4,940,000: W.B.C. 9,000: normal differential count.

17.9.47. X-ray Report, Dr. McKail. "Homogeneous mass 4 x 3 cm. with an ill-defined margin, is seen in the right hilum. It appears to lie partly within the

lower lobe bronchus. Middle lobe shows increased opacity with slight atelectasis.

The appearances are those of a bronchial carcinoma originating in the lower lobe bronchus and causing partial obstruction of the middle lobe bronchus".

17.9.47. Bronchoscopy, Dr. Semple. "Easy passage. Some blood stained mucus in left pyriform fossa. Trachea, carina and left stem bronchus normal. Right upper lobe orifice normal. Just below this, at the level of the right middle lobe orifice, is seen a pink tumour, apparently completely obstructing the stem bronchus and fixed to the wall on the postero-lateral area. Firm to touch.

Conclusion - Possibly adenoma but more like neoplasm".

20.9.47. Biopsy Report, Royal College of Physicians, Dr. Wallace Park.

"1. Bronchogenic carcinoma of epidermoid type. Specimen consists of neoplastic tissue throughout almost its whole extent.

2. Differentiation to squamous pattern; cells not unduly polymorphic. Mitoses numerous."

21.9.47. Allowed home.

1.10.47. Re-admitted. General condition improved.

2.10.47. X-ray Report, Dr. McKail. "Compared with films of 17.9.47 the opacity in the middle lobe is now disappearing. The appearance of the mass in the lower lobe bronchus remains unchanged".

3.10.47. Operation - Mr. Dick, Mr. Barclay.

Dr. Pinkerton -
Oral tube,
Pentothal,
Cyclopropane.

The right lung was removed without great difficulty. Quite a large glandular mass was present at the hilum, close to the oesophagus and the pericardium, but this came away quite easily. The wound was closed with 50,000 units of penicillin being instilled, and a de pezzer catheter was inserted high up antero-laterally.

The tumour was found to be filling the right lower lobe bronchus and acting as a check valve.

Two pints of blood and 1½ pints of saline were given.

4.10.47. Condition good.

13.10.47. Pathological Report, Mr. K. Fraser. "The tumour projects into the main bronchus 1 cm. below the upper lobe bronchus orifice. The intrabronchial portion of the tumour is 2.5 cm. in length and projects 1.5 cm. into and occludes completely the main bronchus.

The tumour has spread into the lung in a fan-shaped manner; its total width is 4 x 3.25 cm. Towards the periphery, there is necrosis. The lower lobe of the lung is spongy and shows bronchiectasis and has a gelatinous appearance.

This is a squamous epithelioma showing considerable degeneration".

14.10.47. He had had a good deal of coughing in the last few days and after a fit of coughing he definitely "blew" his bronchus and coughed up some old blood stained material which had a bad taste. He was not distressed but coughed a good deal. He developed an empyema which was drained and contained staph. aureus, B.coli, B.proteus and B.pyocyaneus.

21.11.47. He was running a mild pyrexia which was persisting and the chest was re-drained at a more dependent level.

17.12.47. General condition remained poor and his bronchus still persisted in blowing.

30.12.47. Operation - Mr. Dick. Dr. Pinkerton - Pentothal, Gas & Oxygen.

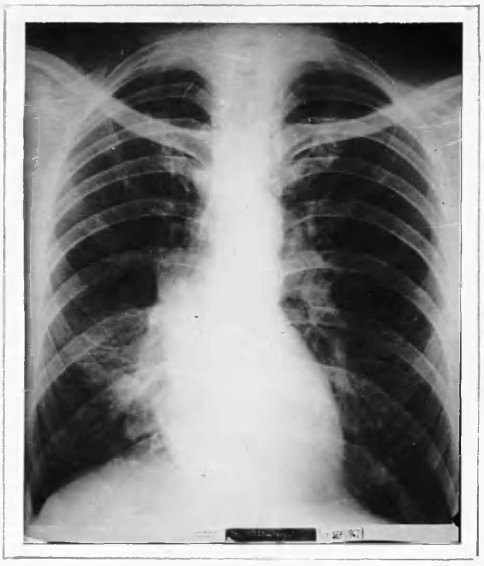
With the patient sitting up a rib resection was carried out and a new tube inserted. A portion of the empyema wall was removed but the histological

examination showed only inflammatory tissue.

6.1.48. He appeared to have developed a broncho-pneumonia on the left side.

16.1.48. He gradually deteriorated and died.

It was thought that he probably had secondaries in his other lung.



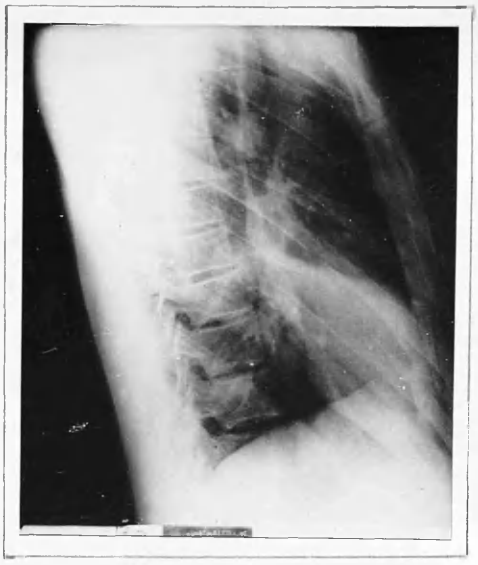


Fig. No. 186. The tumour casts a shadow in the right hilar area. The more dense inverted triangular area just to the right of the heart suggests that there is collapse and consolidation in the middle lobe, this is confirmed on the lateral view by the wedge-shaped shadow running downwards and forwards from the lung hilum. The lower lobe also shows increased opacity which combined with some elevation of the right leaf of the diaphragm confirms that there is some degree of lower lobe collapse. The lower photographs are of tomographs taken at 11 and 12 cm. from the back, i.e. the tumour is fairly centrally situated.

Fig. No. 187. The stem bronchus has been trimmed and laid open. It is just possible to see at the top of the bronchus the dim aperture of the upper lobe bronchus. There is no mistaking the tumour as it lies partly intra and partly extra-bronchial. The intrabronchial portion is 2.5 cm. in length and projects 1.5 cm. into and completely occludes the lumen of the stem bronchus. The tumour has spread in a fan-shaped manner into the lung; it is necrotic at the periphery. The lower lobe (below and to the right) shows pneumonic and atelectatic changes.

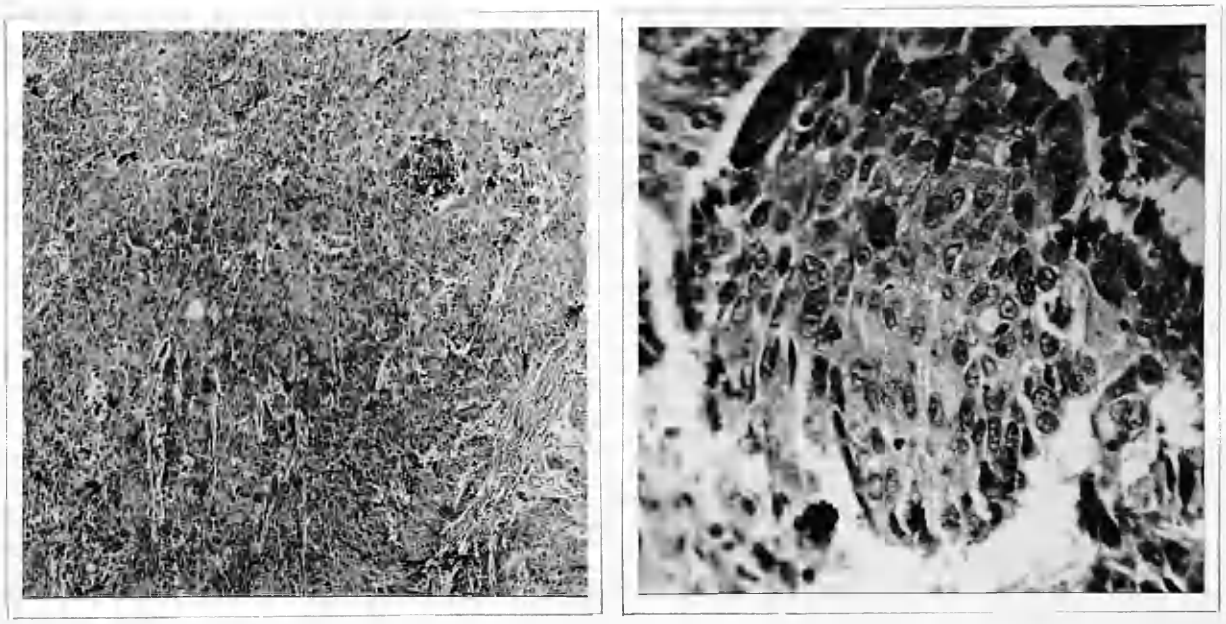


Fig. No.188. The tumour is a squamous epithelioma showing a fair degree of degeneration.

Case No. 56.

R.M. (49), Occupation - Joiner.

Admitted 9.12.48, 17.2.49,

Dismissed 1.2.49. 14.6.49 (Died).

Diagnosis Bronchial Carcinoma.

History. Three months prior to admission he sustained a minor injury to the left side of his chest and had pain for two days. A week later he developed a cough and his spit was heavily stained with blood for three days. For two months prior to admission the haemoptysis recurred repeatedly but during the week preceding admission his cough subsided. He did not complain of pain in his chest, lassitude or general malaise.

He had pleurisy while in New York in 1935 and had suffered from breathlessness on exertion since. This breathlessness has been much exaggerated since he developed a haemoptysis. With rest in bed the dyspnoea had largely disappeared. For two days prior to admission his voice had been husky and he complained of pain at the angle of his left jaw and in his left ear.

Previous health. Diptheria at age of 8.

In 1935 he had a left sided pleurisy and was in bed for six weeks. In 1941 he had recurrent attacks of epigastric pain occurring some hours after food and

relieved by food and alkalis.

In 1941 he had erysipelas.

Examination. He was a normal looking man with a slightly husky voice. There was no enlargement of glands, no cyanosis and no oedema. There was a moderate degree of finger clubbing.

Respiratory system. The vocal cords moved freely but the left cord was pale and markedly erroded and distorted in its middle third, due to a pale ulcer. The percussion note was resonant throughout the chest. The respiratory murmur was vesicular. A few scattered rhonchi were heard throughout both lung fields.

Cardio-vascular system, genito-urinary system, central nervous system showed no abnormality.

10.12.48. X-ray Report, Dr. McKail. "There is an opacity of homogeneous density, somewhat pyramidal in shape, in the axillary pectoral segment of the upper lobe of the right lung. Its margins are well demarcated but show slight irregularity. The mass contains a cavity with irregular walls. There is a fracture of the 10th left rib.

The appearances in the lung are those of primary bronchial carcinoma. The rib fracture is almost certainly metastatic but will be confirmed by tangential projection if desired".

The condition of the vocal cord was investigated by Dr. Howie; a biopsy was carried out and no malignancy was found; his Wassermann Reaction had come back, however, with three +++ and the Khan reaction was also three +++.

He was put on to potassium iodide and bismuth injection.

1.2.49. He was sent out to continue anti-syphilitic treatment and the question of the condition in the lung being a carcinoma was still under consideration.

10.1.49. X-ray Report, Dr. McKail. "Compared with films of 11.12.48, the lesion in the right lung was increased in size. The 10th left rib fracture can be more clearly seen in the present film. It is now evident that this is a traumatic fracture".

17.12.49. He was re-admitted and the condition of his chest, clinically, was found to be the same.

4.3.49. Operation - Mr. Fraser. Dr. Shaw - Pentothal, Cyclopropane, Tuberin.

The right chest was opened through the bed of the resected 7th rib. Apart from an adhesion at its apex, the lung was completely free. This adhesion was divided. No hilar gland enlargement could be detected and the tumour was felt as a firm mass in the upper lobe;

the horizontal fissure was sealed as a result of inflammatory changes. The fissure was opened fairly easily. The venous and arterial supply of the upper lobe was dissected out and transfixed, ligated and divided. The bronchus was then clamped and divided and closed with silk sutures.

The middle lobe was then removed by division and closure of its main artery and bronchus. The lower lobe expanded well. Penicillin-sulphathiazole powder was dusted over the hilum and the wound was closed after instillation of 50,000 units of penicillin. A drainage tube was inserted posteriorly.

Specimen on incision: In the right upper lobe a cavity 1½" x 1" was found. This possessed thick whitish walls and had projecting into it a polypoid mass of firm consistency.

6.3.49. His general condition was anxious. His drainage tube was not working too well.

7.3.49. Pathological Report, Mr. K. Fraser.

"In the lateral segment of the upper lobe there is a cystic area. This cyst is made up of tumour tissue which shows itself as a thin rind of tissue around the apex of the cavity. The cystic space is 3 cm. in diameter. The cystic tumour is 2 x 3 cm. in width.

The wall of the cyst is 1/4 to 1/2 of a centimetre in thickness. In the centre of the cystic space and attached at the inferior aspect of the cyst there is a polypoidal type of tumour which is lobulated and stands 2¾ cm. high and is 1.½ cm. across. It is white in colour. The tumour is beginning to transgress the main fissure and to invade and encroach upon the middle lobe".

7.3.49. Royal College of Physicians, Pathological Report, Dr. Lees. "1. This is what is histologically an undoubted carcinoma.

2. There are masses of large polymorphic and malignant looking cells lying amongst fibrous tissue. There are moderately numerous mitotic figures.

3. The tumour at one area is abutting against lung tissue and elsewhere there is a good deal of necrosis.

I cannot quite fit this into the microscopic description of the tumour at operation, as these specimens appear here, there seems to have been a carcinoma forming the wall of the cyst (whose cavity is necrotic degeneration) and lying in lung parenchyma.

4. As to the structure of the carcinoma, it certainly does not look like the usual run of bronchogenic carcinoma. Assuming it is not a secondary tumour,

there seems a case here for considering this to be derived from alveolar cells - but such a diagnosis would only be justified after consideration of all the data".

8.3.49. The clinical picture of the patient and the x-ray appearances suggested that he had blown his bronchus.

9.3.49. Theatre. A small catheter was inserted through the anterior chest wall in the infraclavicular region as a safeguard.

10.3.49. He was blowing into the bottle on expiration only. His condition was improved.

24.3.49. The lower lobe was slow to re-expand but his condition was now greatly improved and his tube was not blowing so freely.

His convalescence was slow and he continued to require a drainage tube.

21.5.49. He developed a hard circular mass just at the inferior edge of the posterior drainage tube opening. This had all the appearances of tumour and a small portion was removed.

24.5.49. Royal College of Physicians, Pathological Report, Dr. Lees. "The nodule consists of a carcinoma. It is almost sarcomatoid in structure and consists of

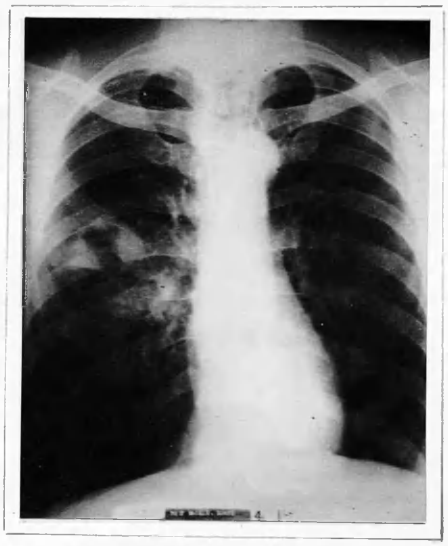
streams of highly malignant polymorphic undifferentiated cells.

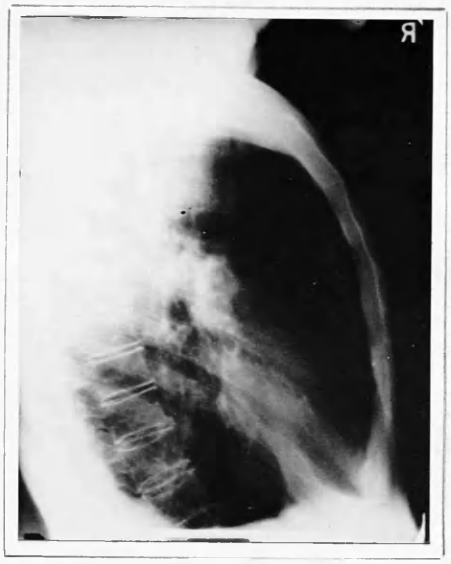
Certainly, it is a carcinoma and conformable with, if not very typical of, bronchogenic carcinoma".

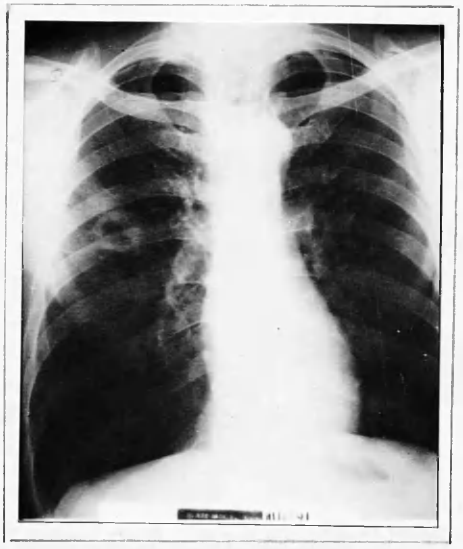
27.5.49. A pint of compatible blood was given and on 28.5.49 a second pint was given.

6.6.49. His condition was deteriorating rapidly and he now had two secondary deposits in his wound.

14.6.49. He died.







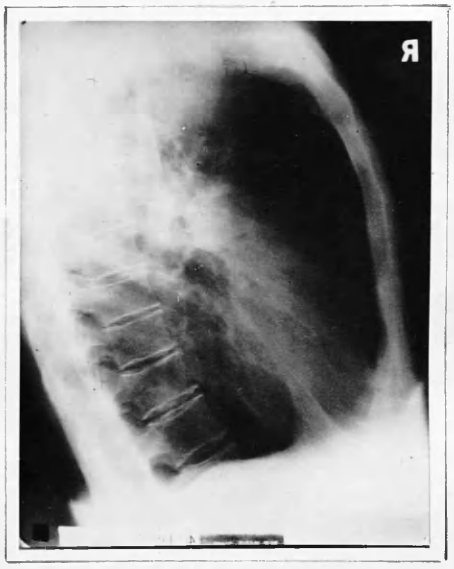


Fig. No.189. The bottom left X-ray photograph was taken on 11.12.48 and it shows a cavitated area due to breakdown in the centre of the tumour; the top right X-ray is a lateral view of the same date and it shows quite distinctly the central tumour polyp projecting upwards within the cavity, it also confirms that the tumour is in the posterior segment of the upper lobe. The top left and bottom right X-rays show the increase in size of the tumour after three months.

Fig. No. 190. The specimen has been cut so as to show the tumour polyp within the cavitated tumour space. The thin rind of tumour tissue surrounding the space is well seen.

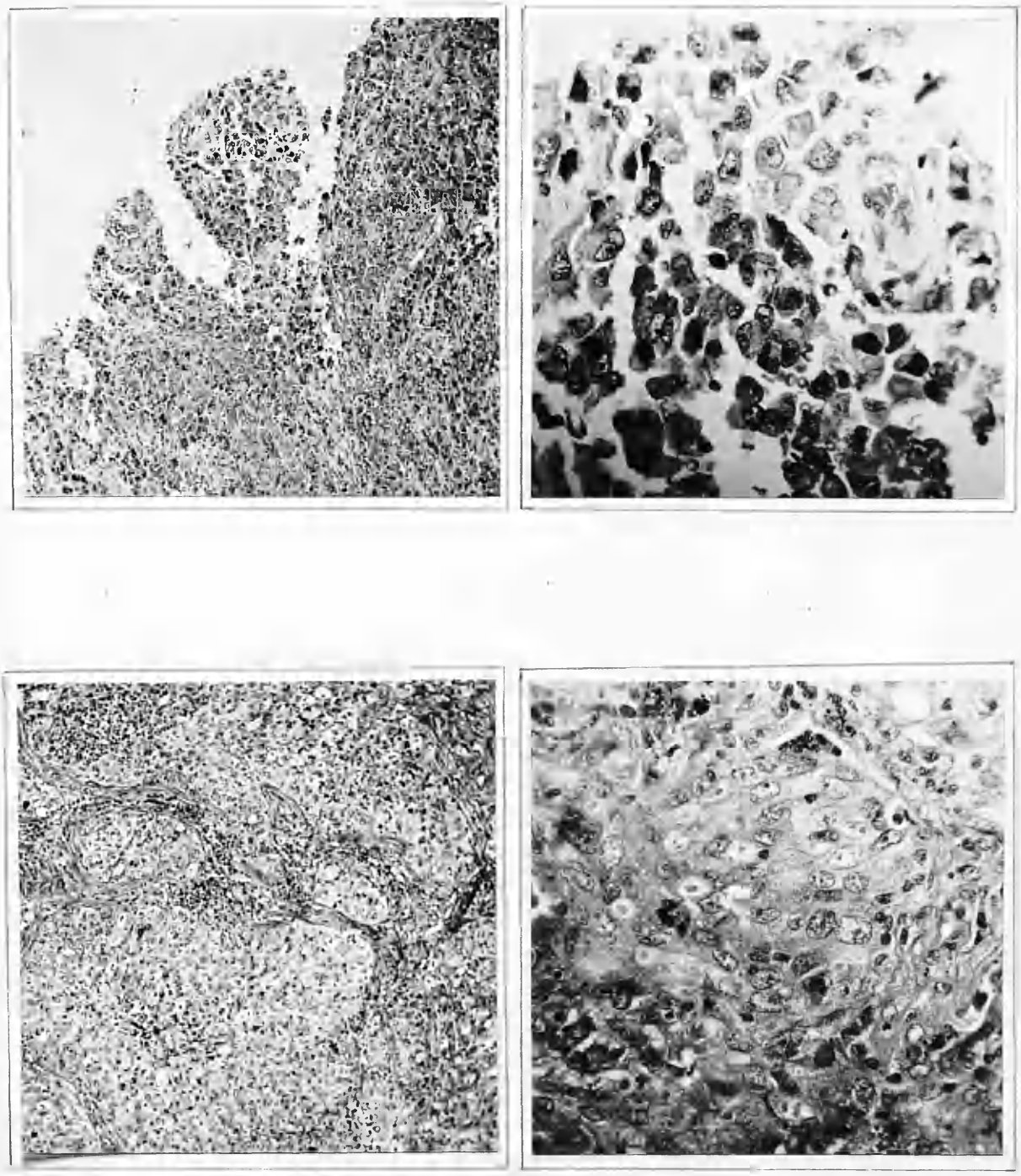


Fig. No. 191. Representative areas of the tumour. The cells are polymorphic and undifferentiated. Mitotic figures are fairly numerous. The upper photomicrographs are from the tumour polyp.

Case No. 57.

J.B. (53), Occupation - Clerk.

Admitted 8.9.50,

Dismissed 23.12.50.

Diagnosis Bronchial carcinoma of left lower lobe.

History. He was well until a year previously when he developed a cough which troubled him at any time of day or night, but was not severe. It was accompanied by whitish thin sputum which on one occasion had been blood stained. He developed an aching pain in the axillary area of his left chest and he noticed that he was becoming easily tired and unduly breathless on exertion. He spent three weeks in bed and several more weeks off his work. The cough and sputum gradually decreased. X-ray examination of his chest was negative. He remained well until April 1950, although he still had a smoker's cough and a little sputum. At this time, his general weakness returned and his cough became worse. The dyspnoea on exertion was more severe and he had to go off his work until the middle of June, as a result his symptoms decreased and he felt much improved. In the middle of August, he had several vomiting spells after meals; he had had anorexia since that time. He began to lose weight. His other symptoms became progressively worse.

Previous health was satisfactory.

Examination. He was a thin rather pale man in no apparent distress. There was slight cyanosis of his lips but no oedema. The fingers were definitely clubbed. There were many hard discrete palpable glands in the left axilla and one or two in the right axilla.

Respiratory system. The thorax was thin and fairly symmetrical. A circular depression at the lower end of the sternum was present. At the inferior and posterior aspect of the left chest there was dullness on percussion and the breath sounds were diminished. Crepitations were audible on inspiration and the vocal fremitus was decreased. The remaining lung fields were clear.

Alimentary system, central nervous system and cardio-vascular system showed no abnormality.

9.9.50. X-ray Report, Dr. Donald. "Appearances in left lower lobe suggest cystic bronchiectasis with probable large abscess cavity in upper and posterior part of lower lobe".

15.9.50. He complained of pain in the left lower chest anteriorly where a pleural rub was heard over the left lower costal margin.

16.9.50. X-ray Report, Dr. Donald. "There is some

increase in collapse of left lower lobe since 9.9.50 and the large cavity is now considerably smaller. There appeared to be small fluid levels in some other of the larger cystic cavities".

20.9.50. Bronchoscopy, Dr. Semple. "Trachea, carina and stem bronchi normal. At the level of the left upper orifice there is a red bulging area on the medial wall of the left lower bronchus, medium hard. No complete obstruction. Distal orifices seen in part. No pus present. Biopsy taken".

29.9.50. Pathological Report, Victoria Infirmary. 2373/50, Dr. Steven. "Microscopical appearances are those of a capillary epidermoid carcinoma of bronchus. The structure is that of capillary processes with vascular fibrous cords invested in thick layers of epithelium. Cells are of large fusiform or polygonol type with irregular nuclei in which the chromatin is finely dusted and the nucleoli prominent; large aberrant forms are often seen and there are numerous mitoses, often atypical in pattern. Secondary infection is mild in degree.

Bronchial biopsy - Epidermoid carcinoma".

27.9.50. He was aspirated and six ounces of greenish-yellow pus obtained from the left lower chest posteriorly

and 250,000 units of penicillin were instilled.

9.10.50. General improvement. Low intermittent pyrexia present. Two ounces of sputum.

7.11.50. He was prepared for operation to-day, but for a few days he had been running an intermittent pyrexia which increased, and he appeared to have an accumulation of fluid at his left base so the operation was postponed.

8.11.50. His chest was aspirated, pus was withdrawn and penicillin was inserted.

21.11.50. Operation - Mr. Fraser, Mr. McCluskey.

Dr. Robson -
Pentothal,
Cyclopropane,
Gas & Oxygen.

Right main bronchus blocked with bronchus blocker.

With the patient in the prone position, the line of incision was infiltrated with 1 in 500,000 adrenalin. Using a postero-lateral incision, the 6th and 7th ribs were resected with conservation of the intervening intercostal bundle. The parietal pleura was incised and the pleural space found to be obliterated. The upper lobe was easily separated from the parietes and the lower lobe was left attached to the chest wall and diaphragm. The tumour mass could be felt on the medial aspect of the lower lobe and appeared to

encroach further up the stem bronchus than bronchoscopy suggested. A soft enlarged gland lay at the hilum at the level of the aortic arch and there was a hard invaded gland in close association with the tumour. The hilum was exposed by incising the mediastinal pleura over the arch of the aorta; the pleura was stripped downward together with the enlarged gland. The bronchus was cleared as far up as carina and then a toothed clamp was applied. The bronchus was cut proximal to the clamp and closed with a continuous double threaded silk suture, the bronchus was cut across piece by piece and simultaneously stitched. The object of this was to avoid any occlusion clamp whatever on the proximal end for fear of it affecting the vitality of the stump. Three more proximal mattress silk sutures were inserted to reinforce the closure of the bronchus. The pulmonary artery was ligated with catgut suture just to the left of the ligamentum arteriosum and then divided between two more distally placed silk transfixion sutures. The lower lobe was now further dissected from the mediastinum to which it was adherent, the oesophagus was freed and then the pericardial space was incised. The superior and then the inferior pulmonary veins were in turn ligated with catgut and transfixed with silk sutures and

divided within the pericardium. The lung, free at the hilum, was now dissected off the diaphragm and chest wall, using a combined intra- and extra-pleural stripping. The abscess in the lower lobe of the lung was not opened into. The intercostal bundle, which had been preserved, was sutured over the bronchial stump. The stump tended to retract under the arch of the aorta. This recess under the aortic arch was then partly closed with a fold of parietal pleura stripped off the chest wall. The phrenic nerve was crushed and a small gland lying in the inferior pulmonary ligament was removed for histological examination. Penicillin-sulphamethazine powder was applied to the hilar area, a drainage tube was inserted and the chest was closed. One gramme of streptomycin and 250,000 units of penicillin were instilled into the chest through the catheter.

The patient was turned on his back and bronchoscopy was carried out. The bronchial tree was dry. The bronchus suture line could be seen just below the carina.

His general condition during the operation was very good, his B.P. rarely varying from 120 mms. of mercury. He had simultaneous whole blood, and 1/1,000 procaine in saline transfusions.

Following pneumonectomy, he had daily injections of 250,000 units of penicillin parenterally and 1 gramme of streptomycin into his chest for eight days.

23.11.50. Royal College of Physicians Report, No.6542/5103. "Gland from pulmonary ligament. No evidence of invasion of the lymph node by malignant tissue".

24.11.50. Pathological Report, Mr. K. Fraser. "There is a greyish-white tumour 3 x 2 cm. projecting forwards into the stem bronchus directly opposite the orifice of the upper lobe bronchus. Immediately behind the tumour and in contact with it there appears to be a branch of the pulmonary artery, and immediately below the tumour there is an invaded lymph gland (confirmed histologically). The lower lobe shows pneumonic changes and there is a cavity 6 x 3 cm. filled with blood clot; this cavity had the appearance of an abscess and not of tumour degeneration (confirmed histologically).

The tumour is a moderately well differentiated squamous epithelioma showing some keratinisation. Mitotic figures are fairly frequent".

3.12.50. Very well. Gaining weight.

26.12.50. Discharged.

24.1.51. Reported as an outpatient. He had put on 11½lb. in weight. General condition excellent.

This patient is still alive in December, 1953.

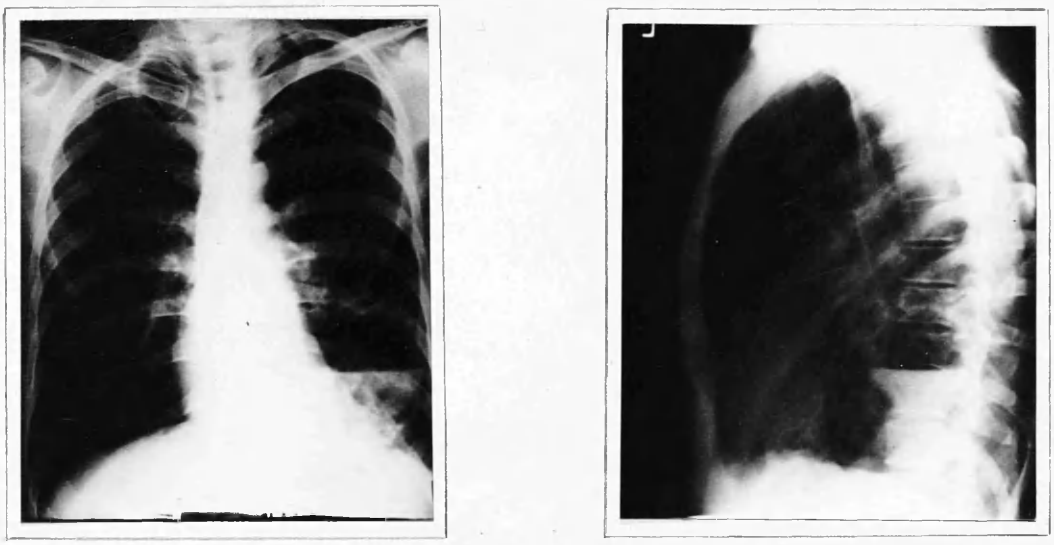


Fig. No. 192. X-ray films on 9.9.50 show the large abscess cavity with a fluid level in the apex of the lower lobe; there is some atelectasis and consolidation around the abscess.

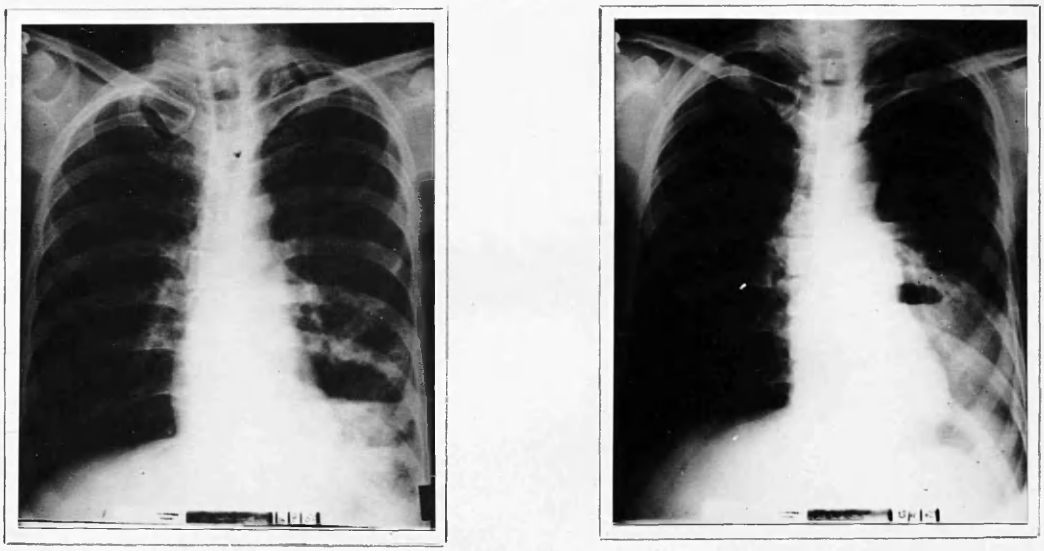


Fig. No. 193. The X-ray film on the left was taken one week later. It shows increased collapse in the lower lobe and some reduction in size of the abscess. The X-ray film on the right was taken at the time when operation was postponed due to pyrexia and increase in dullness at the right base. There is probably some pleural effusion.

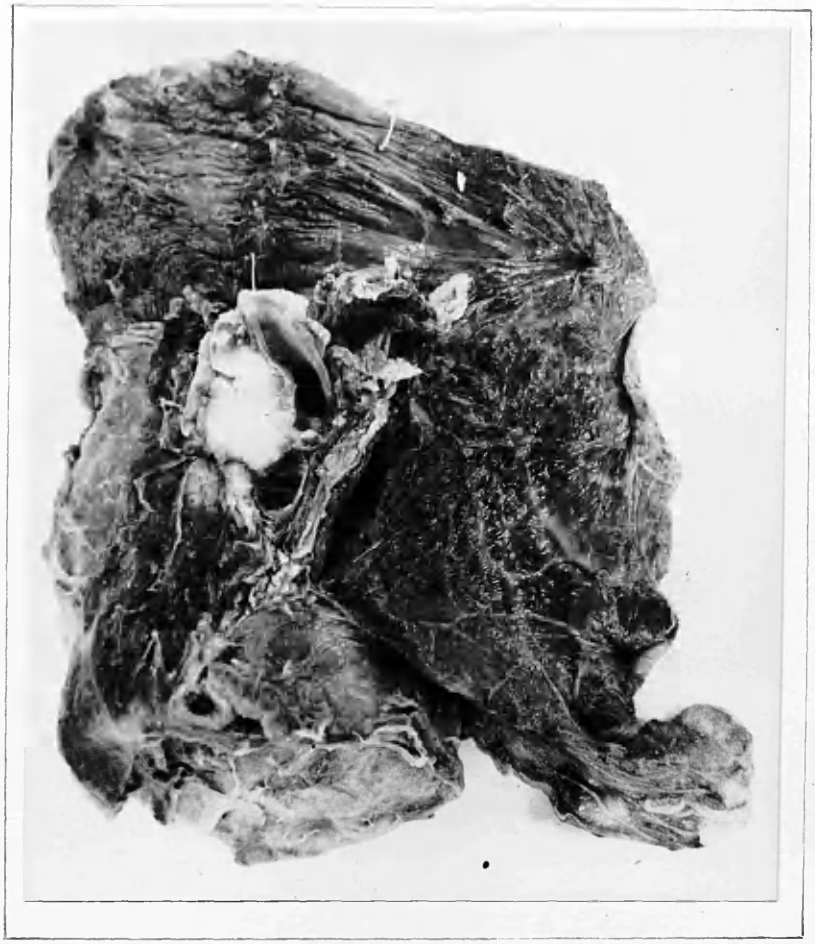
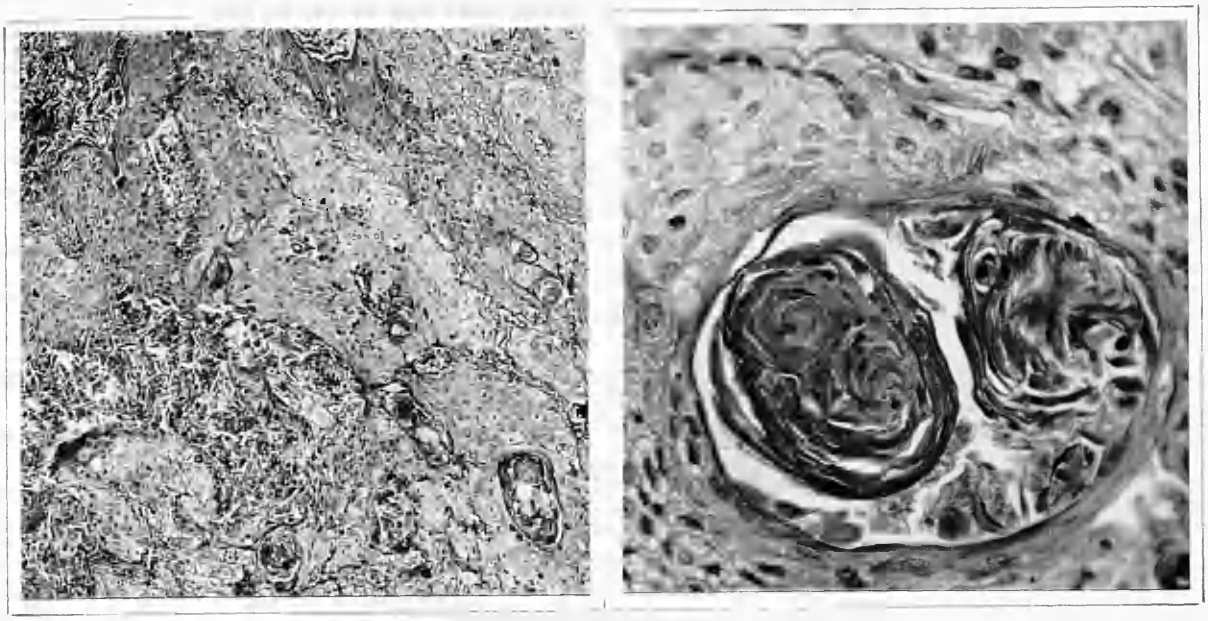


Fig. No. 194. The white tumour is seen to the left of the stem bronchus the posterior wall of which it is pushing forward; the unaffected upper lobe bronchus is visible as a darker area in the depths of the bronchus just to the right of the upper part of the tumour tissue.

Fig. No.195. The reverse side of the specimen shows the large abscess cavity in the lower lobe; the cavity is filled with blood clot.

Fig. No.196. The same as Fig. No.194 after evacuation of the blood clot. There is no tumour tissue in the wall of the broken down area.



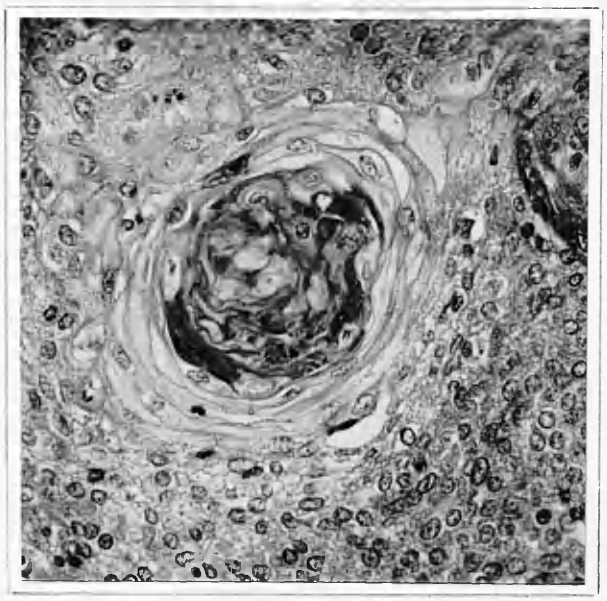


Fig. No. 197. The tumour is a moderately well differentiated squamous epithelioma showing some keratinisation. Mitotic figures are fairly frequent.

Case No. 58.

J.B. (43), Occupation - Crane Driver.

Admitted 17.12.49,

Dismissed 31. 5.50.

Diagnosis Bronchial carcinoma.

History. One year prior to admission he developed a cough. In February, following a bout of coughing, he had a small haemoptysis which cleared up within 24 hours. His general health at that time was otherwise excellent. He reported sick at the time of the haemoptysis and had been kept under observation as an outpatient at Glasgow Royal Infirmary. He had been at work until a few days previously. Since February, his cough had increased in intensity and his sputum had been moderate in amount and muco-purulent. He had had recurring sickness following coughing and his sputum had been blood stained from time to time. He had noticed in the two months prior to admission that he had been lacking in energy. His appetite had remained good and he had not been aware of losing weight. He sometimes had a feeling of tightness across his anterior chest, but no actual sensation of pain.

Previous Health. He had pneumonia and pleurisy in

childhood. His appendix was removed 20 years previously. Otherwise his health had been good.

Examination. He had a pallid complexion and was of average physique. There was no clubbing of the fingers; no appreciable loss of weight; and there was no distension of veins. Some palpable glands were felt in both axillae.

Respiratory system. The chest was symmetrical. There was a degree of impairment to percussion at the right base posteriorly, where the respiratory murmur was slightly diminished. Otherwise his chest was normal.

Cardio-vascular system, alimentary system, genito-urinary and central nervous system showed no abnormality.

9.12.49. X-ray Report, Dr. McKail. "There is a mass of homogeneous density in the lower part of the right hilum, measuring approximately 3 x 5 cm. Its margins are well defined. There is associated atelectasis and bronchiectasis in one of the basal segments of the lower lobe of the right lung.

The appearances suggest a bronchial adenoma, but a carcinoma cannot be excluded".

21.12.49. Bronchoscopy, Dr. Semple. "Trachea, carina and stem bronchi normal. The distal and segmental

orifices of the right lower lobe are blocked by reddish tissue. The cardiac and apical orifice of the right lower lobe are normal.

Biopsy from distal segment orifices (which was followed by discharge of pus from blocked segment)".

26.12.49. Royal College of Physicians. 1507/6367. Dr. Dawson. "Epidermoid carcinoma. Both intra-mucosal and submucosal - malignant mucosal epithelium (pre-invasive) shows numerous mitotic figures. The deeper tumour area is less compactly cellular with polymorphism, but degenerate looking with few mitoses. Other fragment shows no tumour, but a hyperplastic surface epithelium, mucous glands and a chronic inflammatory reaction".

13.1.50. Operation - Mr. Fraser, Mr. McCluskey. Dr. Pinkerton.

The right hemithorax was entered by resecting ribs 5 and 6 and conserving the intervening intercostal bundle. The upper lobe was perfectly free, the only adhesions present being inflammatory ones between the lower lobe and the diaphragm. The mediastinal pleura was incised around the hilum and the bronchus was secured and clamped. Several glands on the main bronchus at its termination with the trachea were removed for

histological examination.

The pulmonary artery and then the superior pulmonary vein and inferior pulmonary vein were isolated, doubly transfixed, ligated and divided, the bronchus was clamped and divided and the lung was removed. The bronchial stump was cut off close to the carina and closed with a double layer of silk sutures, a proximal row of interrupted sutures and a distal row of single interrupted sutures, the proximal row being so placed that the layer of closure would lie at the level of the carina. The intercostal bundle was then sutured over the bronchial stump. The phrenic nerve was crushed. Penicillin-sulphathiazole powder was instilled into the chest over the hilar stump and the chest was closed with a drainage tube.

Pathological Report, Mr. K. Fraser. "There is a white tumour, 3 x 3.25 cm. in extent, encircling the lower lobe bronchus more extensive on the posterior aspect of the bronchus. The tumour spreads proximally to within 1.5 cm. of the middle lobe bronchus. There appears to have been invasion of a lymph gland on either side of the lower lobe bronchus. Distal to the tumour, the lobe is consolidated and shows bronchiectasis in its posterior divisions".

Histological Report. "This is a moderately well differentiated squamous epithelioma. Some tumour areas show degeneration".

17.1.50. Royal College of Physicians, Dr. McGregor. "Hilar glands show no evidence of malignancy. Sections of lung showed no malignancy".

(Bronchoscopic histology showed epidermoid carcinoma). Following operation he had a course of 33 gms. of streptomycin.

27.5.50. Creamy pus - 200 c.c. in amount - aspirated from chest. Staph. aureus obtained.

31.5.50. Allowed home. Well.

13.10.50. Reported as an outpatient. He had put on one stone in weight.

6.11.50. Reported. General condition poor. He had a cough with profuse spit. Dull at right base.

1.12.50. Re-admitted. Copious pus obtained from chest. Pus contained Staph. aureus and B.pyocyaneus.

8.5.51. Thoracoplasty was performed by Mr. Fraser.

9.12.53. Reported. Still has a discharging sinus. Still thin but otherwise well.

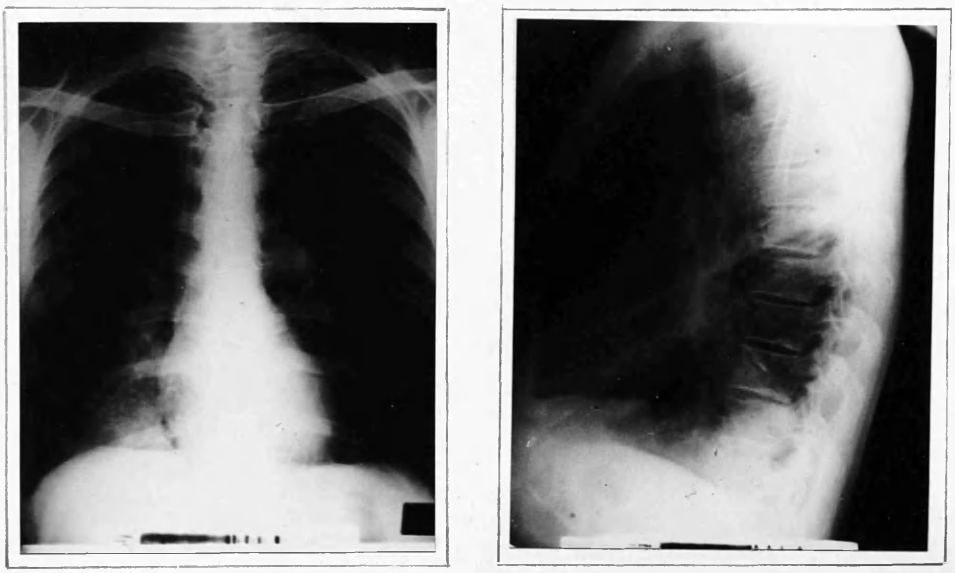


Fig. No. 198. The shadow cast by the tumour and the area of bronchiectasis and consolidation in the posterior segment of the right lower lobe is well seen.

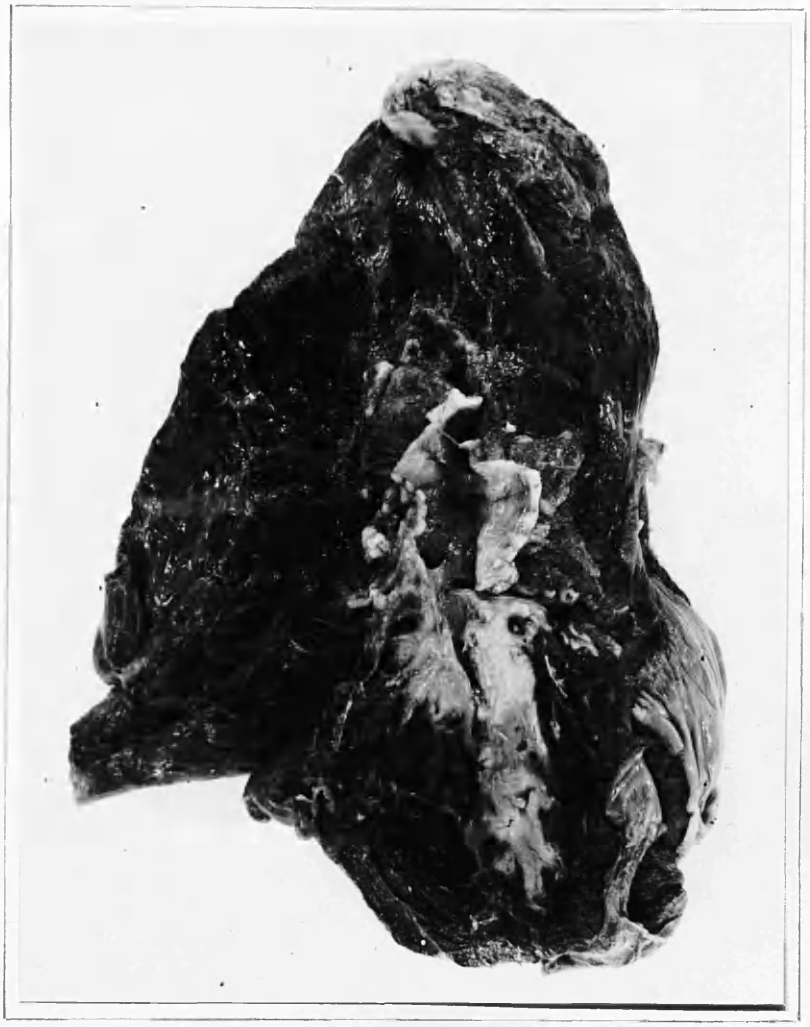


Fig. No. 199. The white tumour 3 x 3.25 cm. in size can be seen encircling the lower lobe bronchus particularly around its posterior division; distal to the tumour gross bronchiectatic changes have occurred in the posterior segmental division. The tumour extends in a proximal direction to within 1.5 cm. of the middle lobe bronchus; the orifice of the latter can be seen on the left side of the stem bronchus, immediately below this orifice is the opening for the bronchus to the apex of the lower lobe. The upper lobe orifice can be seen right at the top of bronchus; it opens directly away from the camera.

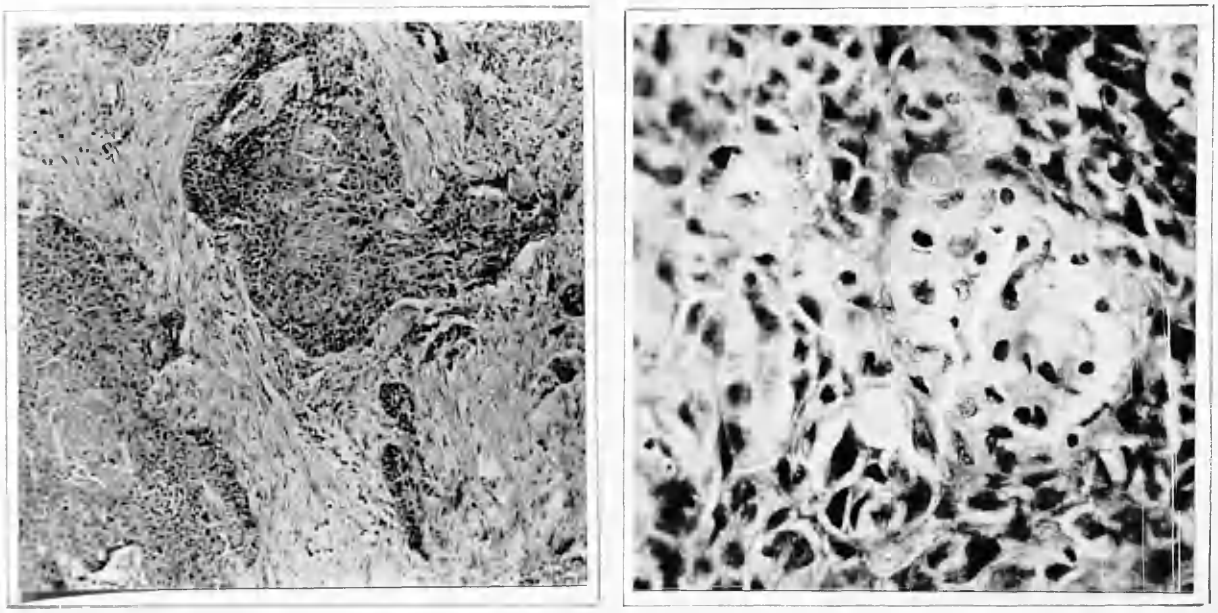


Fig. No. 200. A moderately well differentiated squamous epithelioma with areas of degeneration.

Case No. 59.

E.G. (42). Occupation - Housewife.

Admitted 2.3.46.

Dismissed 10.7.46. (Died).

Diagnosis Carcinoma of lung.

History. In October 1945 she developed severe continuous scapular pain which lasted for two days. She was admitted to Belvidere Hospital as a ? pneumonia. She made a rapid recovery from the pain and was transferred to Ruchill Hospital because of certain findings on X-ray of her chest. Since then she had remained well; there had been no loss of weight, no cough, no spit or haemoptysis, but there was slight breathlessness on exertion.

Examination. She was a stout, well built woman of good colour. There were no glands palpable in the neck or axilla.

Respiratory system. The percussion note was impaired on the right side of the chest and the vocal resonance was within normal. R.M. was vesicular.

Alimentary system. No abnormality.

Cardio-vascular system. There was a soft secondary vesicular sound.

4.11.46. X-ray Report, Dr. McKail. "Lobulated homogeneous mass at the right hilum, situated between

the eparterial and hyperterial bronchi. The margins are clearly defined and the swelling has a lobulated appearance. It is 5 x 5 cms. - Bronchial carcinoma".

5.3.46. The patient was put on to breathing exercises and given liquor arsenicalis.

18.3.46. Haemoglobin was 76%. One pint of Group 'O' blood was given.

19.3.46. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
2% Anaethaine,
Pentothal,
Cyclopropane.

"The chest was opened by the usual right postero-lateral incision. At first the tumour seemed to be inoperable due to some hilar glands which were adherent to the superior pulmonary vein, one of which was also adherent to the left axilla, from which it was freed with some difficulty. The various structures of the hilum were dissected out and secured and the lung was removed. A catheter was passed into the third interspace in the axillary line. Penicillin was put into the chest and half a pint of plasma (this latter was recommended by Mr. Jeffrey, who maintained it helped to fill the space in the chest). The wound was closed."

20.3.46. She was fairly comfortable and drained a fair amount of fluid through the catheter.

Pathological Report, Mr. K. Fraser. "There is a tumour involving the apex of the lower lobe 3½ x 4 cm. which appears to surround and arise from the bronchus to the apex of the lower lobe. The tumour encroaches on and follows the edge of the main lower lobe bronchus in proximal and distal directions for some distance. Peripherally the tumour invades the lung tissue and gives a gorgonzola appearance. Two glands on the opposite sides of the bronchus were invaded; one at the level of upper lobe bronchus, the other lying between the origin of the middle and lower lobe bronchi. The tumour has reached the pleural surface on the reverse side of the specimen. The pleura is not apparently penetrated.

This is an undifferentiated bronchogenic carcinoma. Small oval and oblong cells are seen streaming in solid sheets and masses without any clear attempt at arrangement. There is considerable variation in the size of the cells. There are quite a number of mitoses".

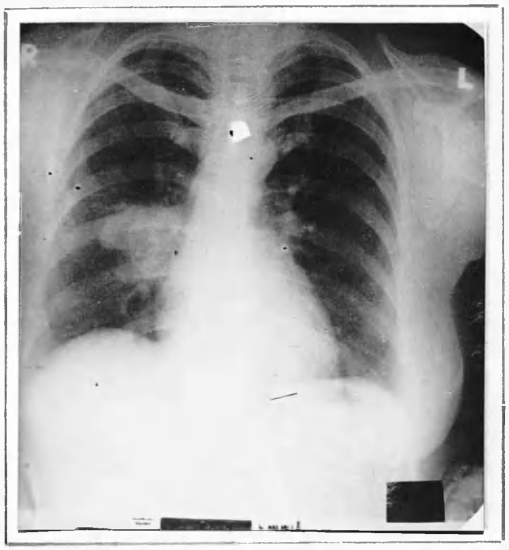
2.4.46. She was allowed up.

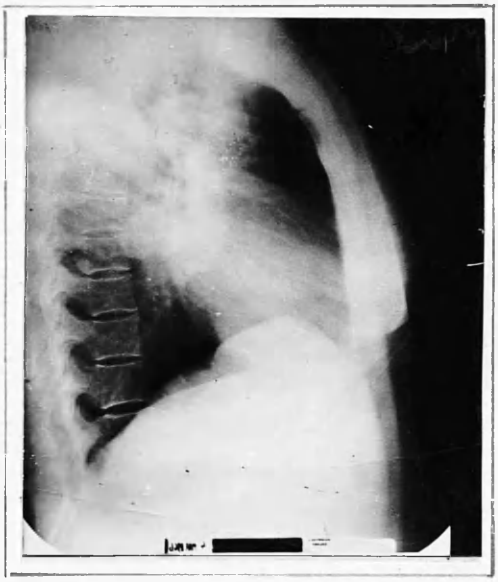
23.4.46. She had developed an empyema and a tube was inserted into the chest. The pus contained staph. aureus and B.coli.

16.5.46. X-ray Report, Dr. McKail. "There is destruction of the transverse process of the 4th lumbar vertebrae. This is almost certainly due to metastasis".

2.7.46. She was very weak.

10.7.46. She died.





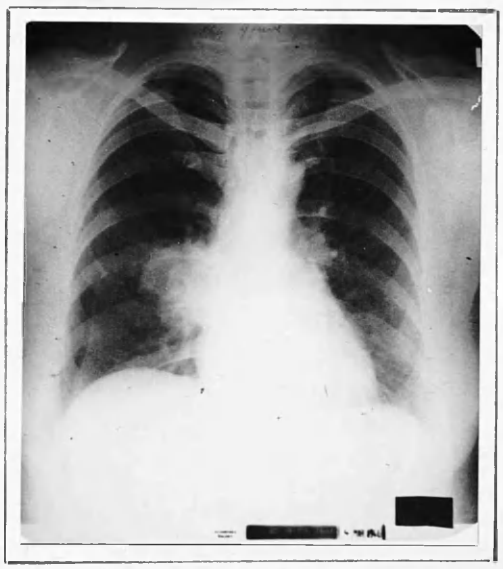


Fig. No.201. The top two photographs show the tumour shadow to be in the hilar area of the bronchus to the apex of the right lower lobe. The lateral view suggests that there is some collapse of the apical and posterior segments of the upper lobe but this is not confirmed on reference to the specimen. The lower photograph shows the lung lying free from the chest wall after the induction of an artificial pneumothorax.

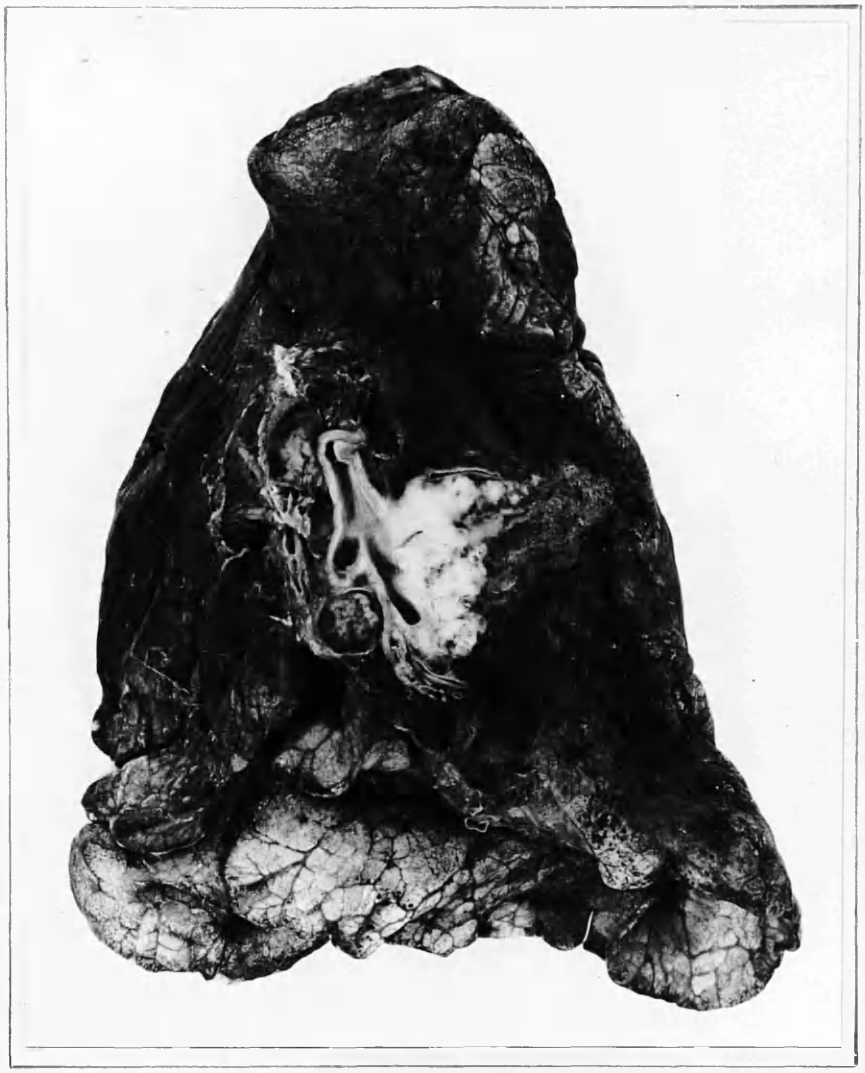
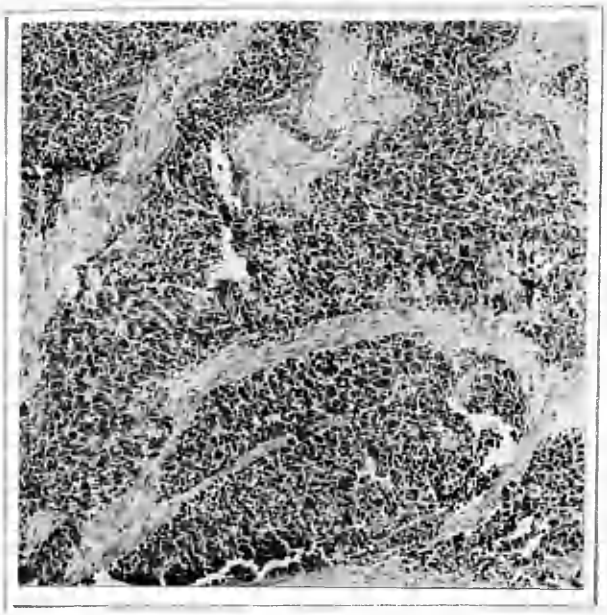
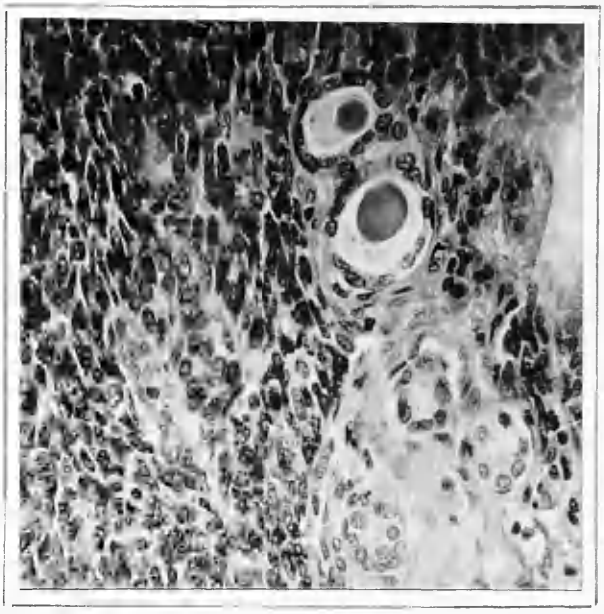


Fig. No.202. The lung has been cut across to open the bronchial tree and reveal the tumour. At the top of the bronchus the upper lobe orifice is just visible. The white tumour, 4 x 3.5 cm. in size, occupies the apex of the right lower lobe; the apical bronchus has been compressed into a narrow slit; directly opposite this bronchus can be seen the opening into the middle lobe bronchus, immediately below this opening there is an invaded lymph gland. A further invaded gland can be seen at the left hand side of the upper lobe bronchus. The tumour has invaded the wall of the stem bronchus over some distance but oddly enough has not ulcerated through the epithelium.





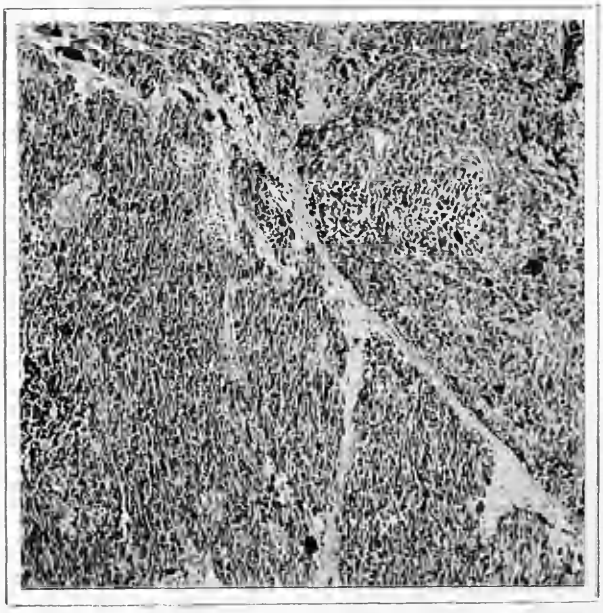


Fig. No.203. This is an undifferentiated bronchogenic carcinoma. Small oval and oblong cells are seen streaming in solid sheets and masses without any very clear attempt at arrangement. There is considerable variation in the size of the cells. There are quite a number of mitoses.

Case No. 60.

A. McT. (50). Occupation - Driller.

Admitted 4.10.50,

Dismissed 21.3.51.

Diagnosis Bronchial carcinoma.

History. Until the beginning of September he had had good health apart from chronic bronchitis. At this time he developed an acute left sided pneumonia and was admitted to the Western Infirmary. He was diagnosed as having a haemophilus pneumonia and was treated with penicillin and streptomycin. X-ray at that time revealed a circumscribed shadow at the left lung root and this was considered to be a bronchial carcinoma. The pneumonia resolved with treatment and the consolidation seemed to disappear. He was transferred to Hairmyres, and on the day of admission, he coughed up some fresh blood. He had had some pain in his left lower chest which was relieved by poultices. There had been no loss of weight or anorexia and no pains in his chest.

Previous health. He had bronchitis and rheumatism in his knees for some time.

Examination. He was a rather pale man of moderate nutrition. Small glands were palpable in both

axillae and there was a slight degree of clubbing of the fingers.

Respiratory system. He had a moderately well developed thorax. There was diminished movement of the left lower chest and over the left lower and mid-zones posteriorly, numerous rhonchi were heard. The respiratory murmur was of normal distribution and there was no loss of resonance to percussion.

Alimentary system, cardio-vascular system and central nervous system showed no abnormality.

6.10.50. X-ray Report, Dr. Donald. "There is a well circumscribed opacity situated in the region of the left hilum. There is commencing collapse of the left side of the chest. Probable bronchial carcinoma".

4.10.50. Bronchoscopy, Dr. Semple. "Trachea and carina normal. Right stem bronchus normal. Left stem normal down to left upper lobe orifice which is seen to be partially blocked by extrinsic growth which involves the lateral wall of the lower lobe bronchus just below this point. Biopsy from the carina between the left upper lobe and the left lower lobe bronchi".

11.10.50. Histological Report, Victoria Infirmary, Dr. Davidson. "Microscopical appearances are those of a bronchial carcinoma of oat-cell type which is invading

the submucosa in the present specimen. The tumour cells are small, closely packed with dense nuclei and scanty cytoplasm. No mitoses are evident. The overlying mucosa shows moderate inflammatory changes with oedema of the sub-epidermal collagenous tissue and a patchy infiltration by plasma cells, lymphocytes and eosinophils, in that order of frequency.

10.10.50. Operation - Mr. Fraser, Mr. McCluskie.

Dr. Robson -
Pentothal,
Gas, Oxygen,
Cyclopropane.

The patient was placed in a face-down position and the left hemithorax was opened through a postero-lateral incision, resecting ribs 6 and 7, with conservation of intervening intercostal. There was no free fluid nor any adhesions between the lung and parietes. The tumour mass could be felt close to the hilum and seemingly gripping the stem bronchus where it gave off its upper lobe branch. It formed a circular mass firm in consistency, about 2½" in diameter, and encroached along the pulmonary veins almost to the pericardium. Several small glands were removed from the hilar area, all apparently normal. One large gland about 1" long lay embedded in lung tissue behind the stem bronchus and was fluctuant on palpation.

The posterior mediastinal pleura was incised and the left stem bronchus was exposed and clamped. Dissecting anteriorly the pulmonary artery was secured just beyond insertion of the ligamentum arteriosum and divided distal to a catgut ligature and a silk transfixing suture. On opening the pericardial sac the superior and inferior pulmonary veins were exposed as they joined to form a common trunk which was ligated with catgut, transfixed with silk sutures and divided. The bronchus was now cut across and the lung was removed.

The bronchus was closed by a series of interrupted silk mattress sutures and then the conserved intercostal bundle was stitched over the bronchus stump. The mediastinal pleura was then almost completely closed over the hilar stump, which had been thickly covered with penicillin-sulphamethazine powder. The phrenic nerve was now crushed and the chest was closed with an intercostal drain through a stab incision; penicillin was instilled.

Six pints of blood were given during and after the operation.

11.10.50. He drained 26 ounces. He was satisfactory as far as pulse and circulation were concerned but was having great difficulty in getting his sputum up.

Some moisture was heard in the right lung.

12.10.50. He was getting up his sputum but still had a considerable quantity.

12.10.50. Royal College of Physicians Laboratory. Pathological Report, Dr. McGregor.

"1. Specimen of lung tissue - Bronchogenic Carcinoma.

2. Structures of sheets of closely packed undifferentiated round or oval cells showing nuclear hyperchromatism and numerous mitotic figures.

3. Consists entirely of tumour.

4. No prickle cell or keratin formation - Undifferentiated oat cell (oat-cell carcinoma).

5. Hilar gland - An anthracotic lymph node showing no invasion by tumour".

It is interesting to note that bacteriological examination of the fluctuant gland showed a scanty growth of penicillin sensitive staph. aureus.

16.10.50. The drainage tube was removed in theatre.

18.10.50. Pathological Report, Mr. K. Fraser.

"Immediately below the origin of the upper lobe bronchus there is a white tumour 4 x 2.5 cm. which appears to be pushing upwards between the lower and upper lobe bronchi. The mucous membrane, though pushed up, is not ulcerated. One enlarged gland was found to be invaded above the

stem bronchus. The lower lobe showed atelectatic and pneumonic changes.

The histological sections showed the tumour to be an oat-cell carcinoma with considerable variation of the size and staining quality of the tumour cells".

23.10.50. His chest was aspirated. 400 c.c. of dark blood stained fluid were withdrawn and 1 gramme of streptomycin and 250,000 units of penicillin were injected. 100 c.c. of air were given as replacement.

11.11.50. Allowed home. Well.

8.12.50. Reported. He was well but very much of "the invalid".

11.1.51. Re-admitted. He was not at all well. It was thought that the bronchus stump must have leaked. Pus was aspirated from the chest and contained staph. aureus and B.coli.

12.2.51. The leak in the bronchus was confirmed by lipiodol. The fluid in the chest was now sterile.

21.3.51. Allowed home.

30.3.51. Re-admitted. Redrained. Allowed home.

20.9.51. His doctor reported his death to-day from secondaries.

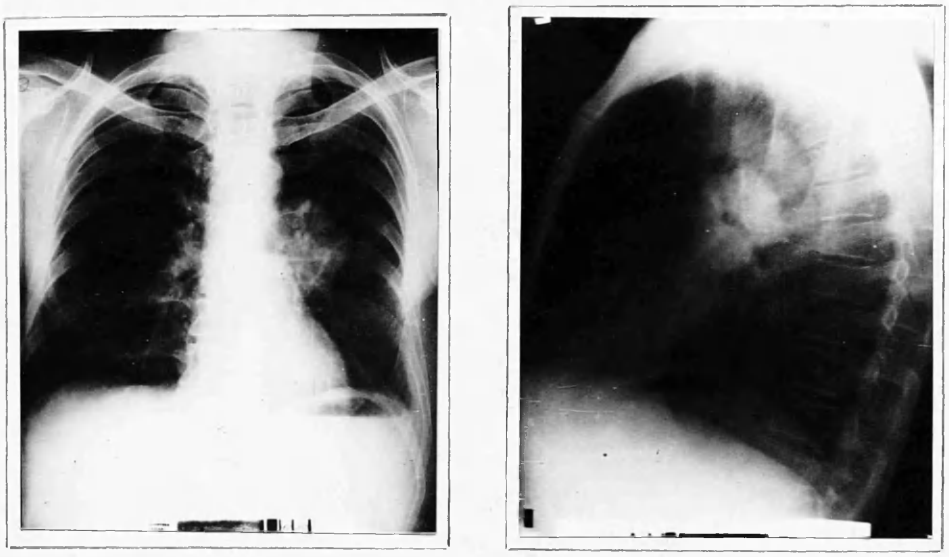
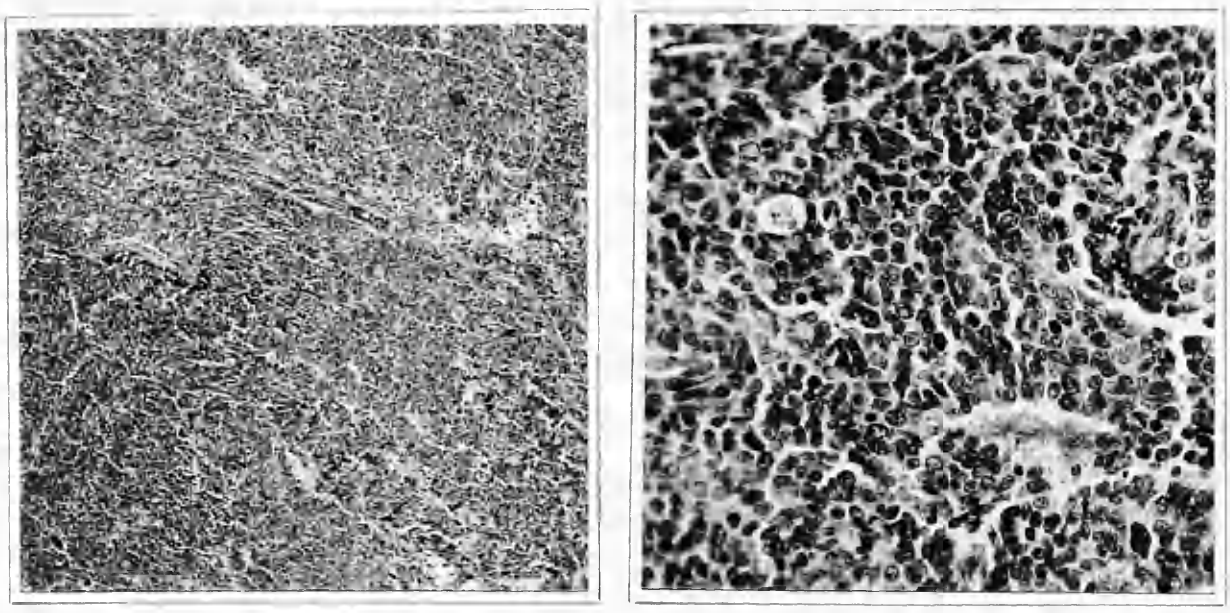


Fig. No. 204. The postero-anterior X-ray film suggests that the tumour is either hilar in site or in the apex of the lower lobe; the lateral film confirms its hilar position, it also shows narrowing of the lower lobe bronchus in the centre of the tumour mass.

Fig. No. 205. The white tumour mass 4 x 2.5 cm. in size is obvious below the stem bronchus. The upper lobe orifice can be seen above the right half of the tumour; the lower lobe bronchus is above the left side of the tumour, it is narrowed by the extraluminal pressure of the tumour. The photograph of the specimen bears comparison with the lateral X-ray film and confirms the hilar position that such X-ray appearances suggest.



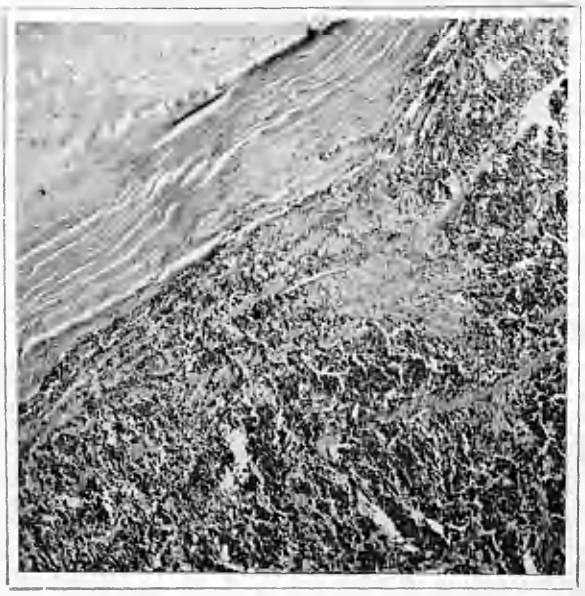


Fig. No. 206. Representative microphotographs reveal the tumour to be an oat-cell carcinoma. The cells show considerable variation in size and in staining quality. The bronchus is being invaded.

Case No.61.

J.M. (58). Occupation - Tourist Agency Manager.

Admitted 30.10.48, 28.12.48,

Dismissed 4.12.48. 12.3.49.

Diagnosis Bronchial Carcinoma.

History. Six weeks prior to admission, while doing heavy digging in his garden, he felt a salty taste in his mouth and spat out half an ounce of bright red blood. Since then he had had only one further small haemoptysis. He had had a pain in the left chest since the original haemoptysis; this pain was sometimes quite severe and was aggravated by deep breathing or coughing. He had noticed only a slight increase in breathlessness on exercise and a slight increase in tiredness. Since 1946 he had had a dry irritating cough and this had become worse during the previous three months. He had lost some weight.

Examination. He was a fairly healthy looking man; well nourished and well preserved. There was no cyanosis, no clubbing of the fingers and no enlargement of glands or oedema.

Respiratory system. There was slight limitation of movement of the left side of his chest. The percussion note was resonant throughout and the respiratory murmur

was vesicular. A few crepitations were to be heard posteriorly over the left mid-zone.

Cardio-vascular system, central nervous system and alimentary system showed no abnormality.

1.11.48. X-ray Report, Dr. McKail. "There is an ovoid mass of homogeneous density measuring 7 x 4 cm. in the axillary division of the apical segment of the lower lobe of the left lung. Its margins are slightly irregular.

The appearances are those of bronchial carcinoma. There is no conclusive evidence of bone involvement".

2.11.48. Bronchoscopy, Dr. Williamson. "Trachea, vocal cords and carina normal. There is pressure from the left on the left main bronchus which bows it medially. The basal bronchi could not be seen as a result. The left upper lobe bronchus seemed normal. Right bronchus normal".

4.11.48. Many dilated venules were seen over the epigastrium in the left costal margin. The left diaphragm was moving normally on x-ray screening.

5.11.48. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Cyclopropane.

The chest was opened through a left postero-lateral

incision following resection of the 6th rib. The lung was free and there were no enlarged glands in the hilum. The mediastinal pleura was incised and the pulmonary artery was readily dissected out, ligated and divided. The inferior pulmonary vein, followed by the superior pulmonary vein, were similarly dealt with. The bronchus was divided between clamps and the bronchus stump was stitched by interrupted silk sutures. It was not possible to cover the stump with mediastinal pleura. The stump was dusted with penicillin-sulphonilamide powder and the chest was closed with an intercostal drain and the insertion of 50,000 units of penicillin.

6.11.48. He was quite well.

11.11.48. He was not well. He was sweating, clammy and was restless. His tube was taken out. By this time he was beginning to have some sputum and some pain in the front of his chest.

15.11.48. Pathological Report, Mr. K. Fraser. "There is a tumour 4½ x 4 cm. involving the apex of the lower lobe and showing well marked submucosal infiltration. At the point of section of the lung, the mucosa appears to be intact. The tumour has reached the pleura which appears to be invaded over an area of 3½ cm., which area is white in colour, but stippled by haemorrhage.

Two glands below the main bronchus do not appear to be invaded but have been sectioned. Submucosal portion of the tumour is white, the rest of the tumour varying shades of green. Further section of the lung shows blockage of the bronchus to the apex of the lower lobe by tumour tissue".

16.11.48. He had improved somewhat, but was still very weak.

16.11.48. Pathology Report, Royal College of Physicians, Dr. Lees. "Gland from root of lung - histological picture shows an anthracotic node showing mild reactive changes. No malignancy or tuberculosis seen".

19.11.48. Fluid from his chest was reported as containing bacillus pyocyaneus and insensitive penicillin staphylococcus aureus. He was much better and his weakness was diminishing.

20.11.48. He coughed up an ounce or two of bloody fluid obviously from the pleural space. He continued to cough up this fluid, which indicated that he had a small broncho-pleural fistula.

29.11.48. He was advised to lie at night on his left side, and following this, he ceased to bring up the blood stained fluid.

1.12.48. No further expectoration. He was now up

and was walking about.

4.12.48. He was discharged home.

28.12.48. Re-admitted. He had been unwell since going home, due to a low grade pyrexia, malaise, anorexia and insomnia. The drainage tube wound had discharged some greenish pus. He had also had some greenish frothy sputum. X-ray at this time showed a fluid level up to the third left costal cartilage, the heart being pushed to the right. A drainage tube was inserted into the pleural cavity.

Culture of the pus obtained showed a scanty growth of bacillus pyocyaneus.

He continued to drain pus from his tube but his condition greatly improved and eventually his wound healed.

10.3.49. Condition excellent and he was dismissed on 11.3.49.

A report was received from his doctor stating that the patient died in July 1949. No secondaries were reported.

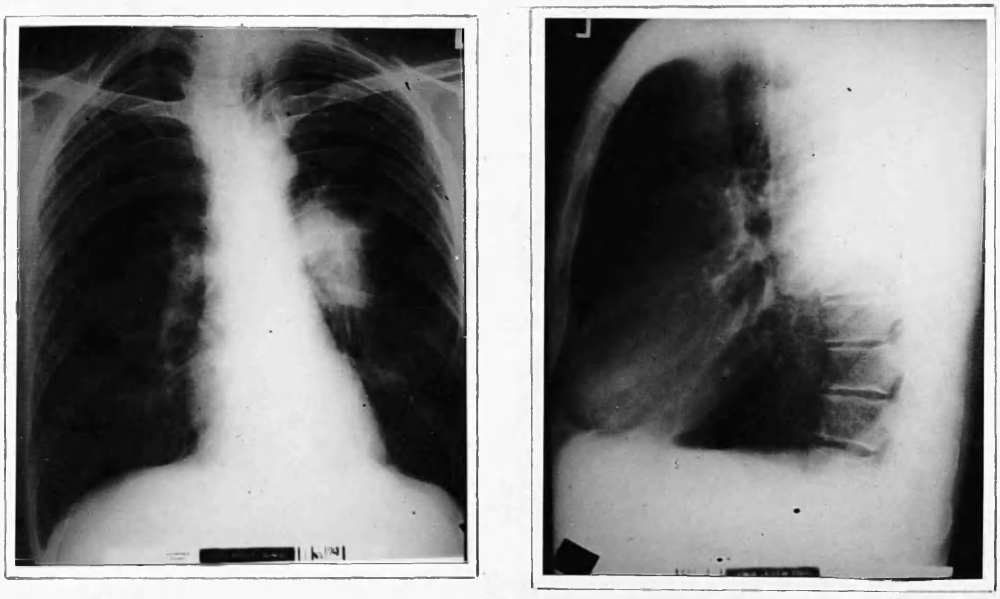


Fig. No. 207. The postero-anterior X-ray photograph shows the tumour apparently close in to the left lung hilum, the lateral photograph, however, reveals the true site, namely the apex of the lower lobe. In the lateral view immediately in front of the tumour shadow a cricular air space is visible - this is the stem bronchus.

Fig. No. 208. There is a carcinoma involving the apex of the left lower lobe. The tumour is 4.5 x 4 cm. and has invaded the pleura over an area of 3.5 cm. The tumour can be seen to be displacing the posterior wall of the lower lobe bronchus thereby narrowing its lumen. The upper lobe bronchus can be "looked into" at the top of the stem bronchus (the stem bronchus has been laid open and trimmed).

Fig. No. 209. This is a deeper section of the same specimen. The almost horizontal slit in the centre of the white tumour tissue is all the lumen left in the bronchus to the apex of the lower lobe, the tumour has occluded the remainder.

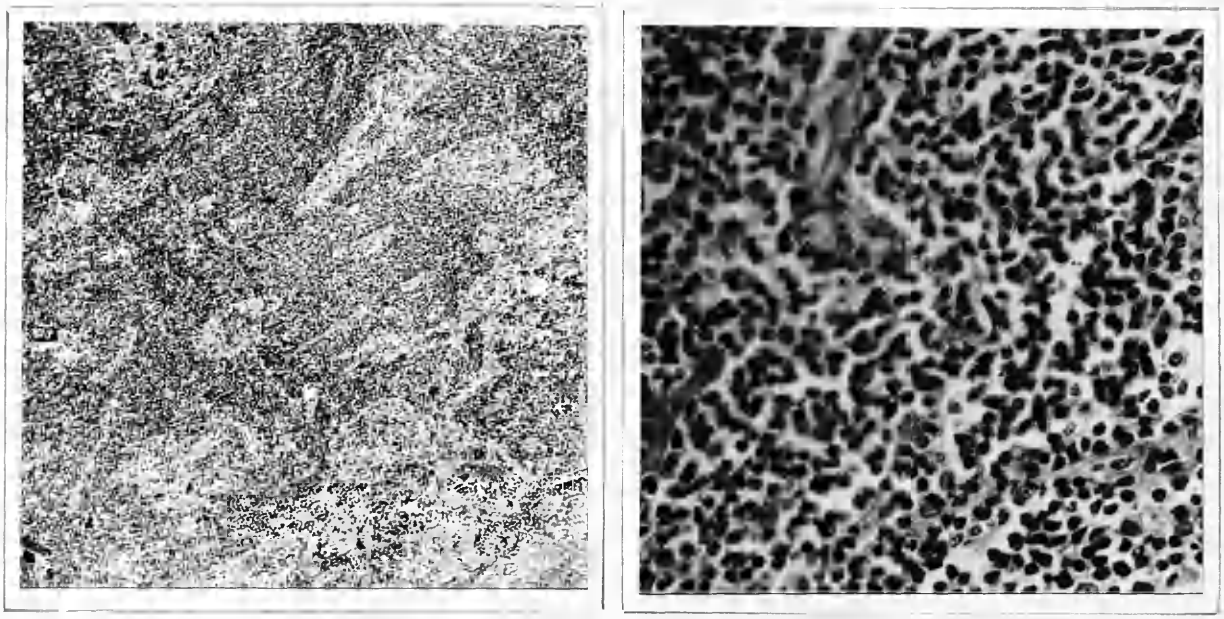


Fig. No. 210. Photomicrographs reveal the tumour to be an oat-cell carcinoma.

Case No. 62.

J.S. (44). Occupation - Police Sergeant.

Admitted 22.5.47,

Died 13.10.47.

Diagnosis Bronchial carcinoma followed by metastases.

History. He had been well until October 1946 when he developed sudden pain in the right chest. He was admitted to the Victoria Infirmary where he was kept in bed for 13 days with a spontaneous right sided pneumothorax. After he was discharged from hospital he developed a chill and diarrhoea. He had always had a cough which, however, he thought had become worse since his illness. He had lost some weight.

He started work on 3.1.47 when he developed a further cold for which he had treatment with M. & B. and was off work for nine weeks. During this time he had had some small haemoptyses and was x-rayed at Ruchill Hospital, when a shadow was found in the left lung. By this time he had regained weight and was actually heavier by ¾ stone than normal.

He was bronchoscoped at the Victoria Infirmary on 7.5.47 by Dr. Howie. On 16.5.47 he had had a further small haemoptysis. On admission to hospital he felt fit, apart from a slight degree of breathlessness.

Examination. He was found to be a well built and well nourished man without cyanosis or dyspnoea; there was no clubbing of the fingers.

Respiratory system. There was equal and good movement on both sides of the chest and no abnormality was found on physical examination.

23.5.47. Blood examination: Hb. 85%, W.B.C.10,000, 70% polys. B.S.R. 5 mm. first hour.

24.5.47. A left pneumothorax was induced. X-ray showed collapse of the lung and no involvement of the chest wall by tumour. The pneumothorax was maintained until operation.

30.5.47. Operation - Mr. Dick. Dr. Pinkerton - Pentothal, Cyclopropane.

The chest was opened by a left postero-lateral incision. A mass was found in the left lung; it was considered to be a carcinoma. Hilar structures were dissected out and a pneumonectomy was performed.

Bronchial stump was buried under a pleural flap. Penicillin was instilled into the chest, which was then closed. A self retaining catheter was inserted into the second interspace anteriorly.

One pint of saline and one pint of blood given during the operation and a further pint of saline and plasma given after the operation.

31.5.47. Condition satisfactory.

1.6.47. 770 c.c. blood stained fluid were aspirated.

5.6.47. Complained of acute ominous encircling pain which came on suddenly during the night and which was followed by a discharge of blood stained fluid.

7.6.47. He was very well but a large amount of air came over the tube and was accompanied by a large deposit in the bottom of the sealed drainage bottle.

10.6.47. Pathological Report, Mr. K. Fraser.

"There is a tumour 4 x 2 cm. in diameter at the apex of the lower lobe close to the origin of the lower lobe bronchus from the main stem bronchus. Immediately above the tumour there is an invaded gland lying against the main bronchus. The tumour is white and the section through the lobe shows what appears to be an abscess 5.5 cm. in diameter in the apex of the lobe. This appearance, however, might be due to necrotic tumour tissue lying in the centre of a rind of thinned out tumour. The bronchus to the apex of the lower lobe is blocked by tumour tissue.

This is a rapidly growing undifferentiated bronchial carcinoma. A hilar lymph gland shows invasion".

17.6.47. He had a swinging temperature and there was a little deposit in the drainage bottle. The spit

was now foul and had increased in amount, previously having been practically nil. By this time it was obvious that he had an empyema after the blowing of his bronchus on 7.6.47.

24.6.47. A drainage tube was inserted in the 9th interspace and a quantity of pus was withdrawn. A growth of B.coli was obtained.

7.7.47. He was allowed up.

7.8.47. He began to complain of pain in his back. His empyema now contained B.coli and B.pyocaneus.

12.8.47. X-ray Report, Dr. McKail. "Bronchography demonstrates a fistulae of moderate size between the stump of the left bronchus and the pleural cavity".

3.9.47. He complained of pain over the right posterior chest at the angle of the scapula. There was some muscular tenderness but no bony tenderness. He had local anaesthetic injected into this area with only slight relief.

19.9.47. X-ray Report, Dr. McKail. "There is collapse of the body of the 7th dorsal vertebrae. This was not present on 23.5.47 and is therefore due to metastatic disease".

10.10.47. By this time he began to have difficulty in reading. This and later findings indicated the

presence of cerebral metastases.

His general condition deteriorated and he became mentally confused.

13.10.47. He died.

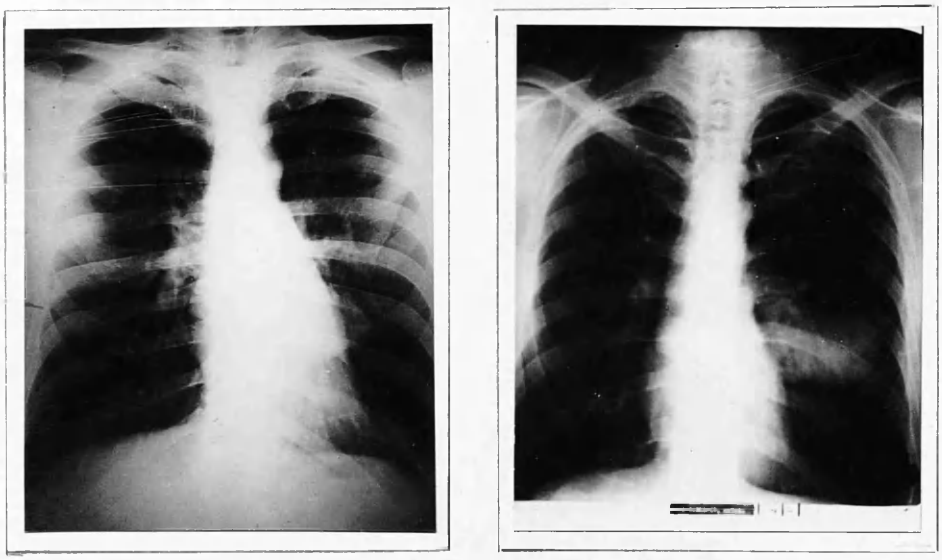


Fig. No. 211. The photograph on the left shows an ovoid opacity towards the left hilar region; it is overlapped in part by the cardiac shadow. The photograph on the right was taken four months later. It shows the enormous increase in the size of the tumour.

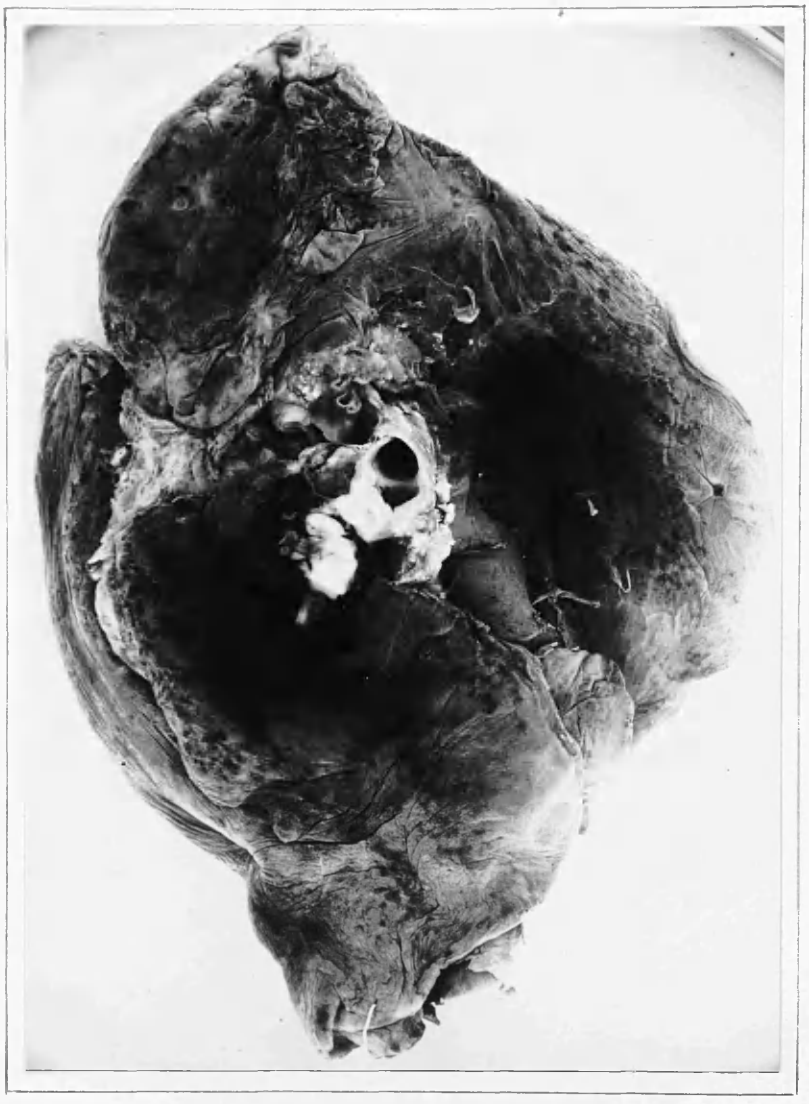


Fig. No. 212. This is the first "cut" of the specimen. The stem bronchus has been cut across. The upper opening is the upper lobe bronchus, the lower is the lower lobe orifice. The lower lip of the cut bronchus is thickened by tumour tissue; the tumour can also be seen as white tissue in the apex of the lower lobe. There is an enlarged and invaded lymph gland in contact with and to the left of the stem bronchus.

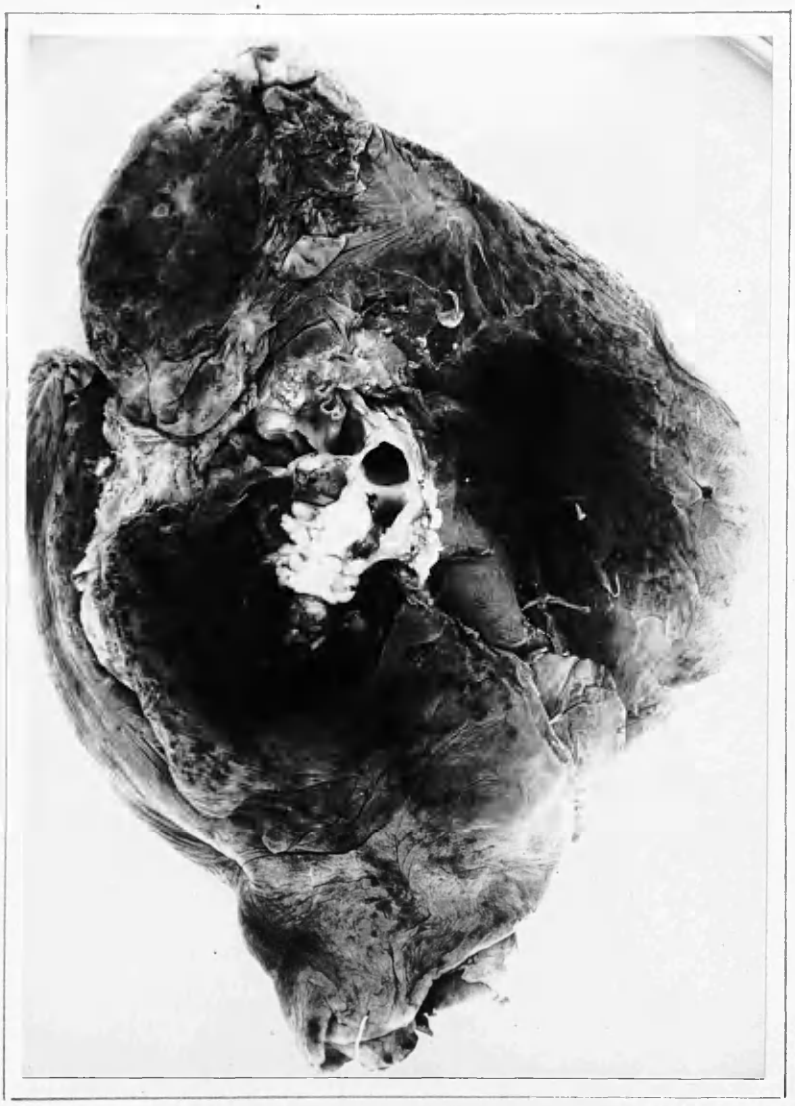


Fig. No. 213. The second "cut" through the tumour has been planned to lay open the bronchus to the apex of the lower lobe to its point of blockage by the tumour tissue. The upper and lower lobe orifices are still visible.

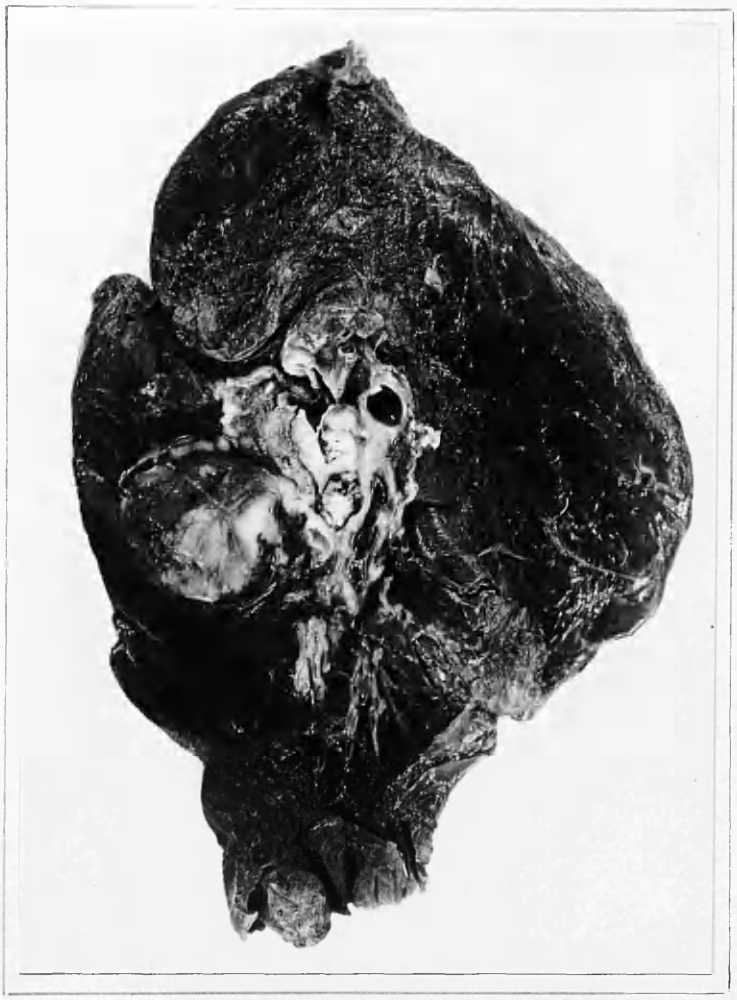


Fig. No.214. A much deeper cut has been taken to reveal the full extent of the tumour. The upper lobe orifice alone is visible, the lower lobe bronchus has been cut away.

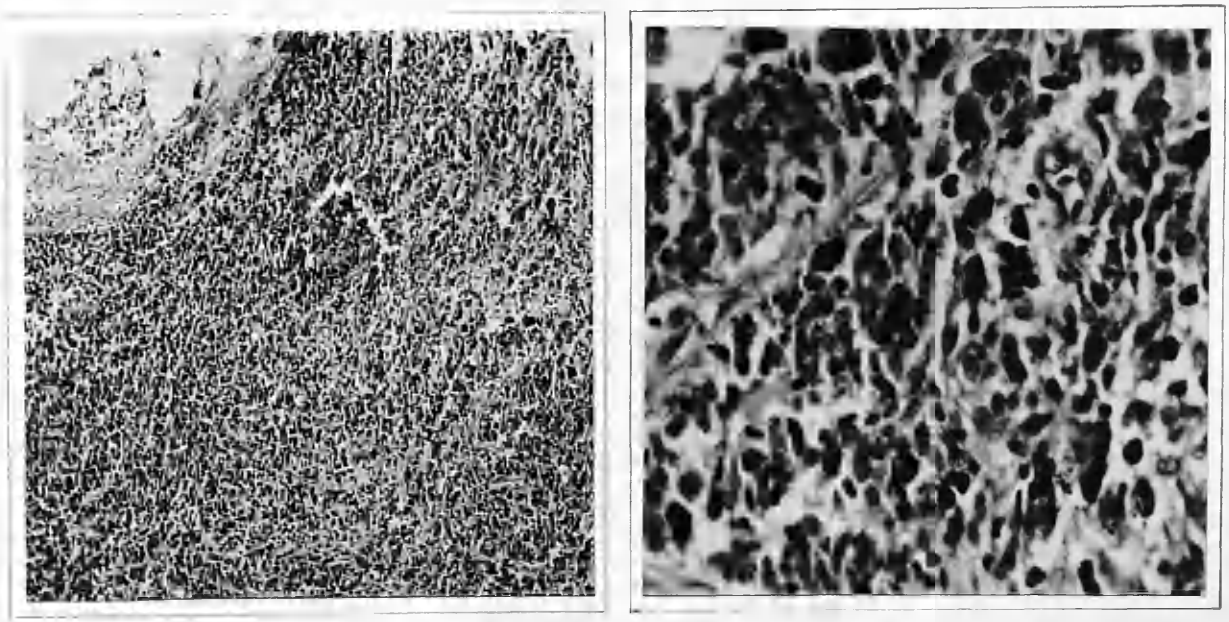


Fig. No. 215. An actively growing undifferentiated carcinoma.

Case No. 63.

B.McM. (45), Occupation - Driller.

Admitted 23.11.48, 9.9.49,

Dismissed 8. 1.49. 16.9.49 (Died).

Diagnosis. Bronchial carcinoma.

History. In February 1948 he quite suddenly developed shortness of breath, a cough, wheezing and variable amount of sputum. He went to bed and his condition improved. Two weeks later he had a recurrence of cough and breathlessness and coughed up some blood which sometimes amounted to as much as a teaspoonful. He was still having shortness of breath on moderate exertion and felt unduly tired. He had lost about a stone in weight.

Examination. He was a rather thin unhealthy looking man. There was moderate clubbing of fingers but no cyanosis or oedema.

Respiratory system. Slight limitation of movement at the right base. The percussion note was resonant throughout. The respiratory murmur was vesicular except at the right base over a localised area where it was bronchial and there were numerous crepitations, especially after coughing. The vocal resonance was increased.

Alimentary system and central nervous system showed no abnormality.

19.11.48. X-ray Report, Dr. McKail. "There is some generalised emphysema. There is a roughly ovoid area of homogeneous density in the posterior basal portion of the lower lobe of the right lung. It shows evidence of cavitation and presents a fluid level. The outer margin of the mass is in parts sharply defined but is rather irregular at its upper margin. The inner wall of the cavity is also somewhat irregular. Some pleural thickening is seen on the right chest wall.

The appearances are most probably due to a breaking down primary bronchial carcinoma".

3.12.48. Operation - Mr. Fraser. Dr. Pinkerton - Pentothal, Cyclopropane.

The right chest was opened through a postero-lateral incision by removing the 8th rib. There was a small amount of serous fluid present in the pleural cavity. Rather filmy adhesions were found between the lower lobe and chest wall and much stronger adhesions anchored the apex of lower lobe to the chest and mediastinum. The lower lobe presented a curious gelatinous appearance; the whole lobe being hard to the touch. The lower lobe bronchus was rapidly

isolated and clamped. The inferior pulmonary artery and then the veins were taken in turn, ligated, transfixed and divided. A second clamp was then applied to the bronchus which was divided and closed with interrupted silk sutures and the proximal clamp was removed. Penicillin-sulphathiazole powder was dusted over the stump. A drainage tube was inserted in the posterior axillary line through the ninth interspace and the wound was closed with penicillin instillation.

10.12.48. He was very well and had no cough or spit.

13.12.48. He was allowed up.

14.12.48. Pathological Report, Mr. K. Fraser.

"There is a carcinoma involving the lower lobe. The tumour area is surrounded by consolidated lung. The centre of the tumour shows breakdown and cavitation over an area 3 cm. in diameter. Beyond the tumour the inferior aspect of the lobe shows pneumonic changes right up to the diaphragmatic surface; over this area the pleura shows considerable thickening.

The histological picture is that of a fairly well differentiated squamous epithelioma which shows a moderate degree of keratinisation".

8.1.49. He was discharged home.

9.9.49. Re-admitted. He was complaining of breathlessness and marked lethargy for three weeks. Prior to that time he had been able to move about quietly without distress. He had not enjoyed good health since his operation. On examination, he was comfortable. His chest showed a moderate degree of bronchospasm with rhonchi.

14.9.49. He became acutely breathless in the evening and cyanosed. Examination revealed diffuse rales in his chest. There was no impairment at his bases. The respiratory murmur was coarse vesicular. He had acute pain over his left lower chest.

15.9.49. His chest was quite moist and he was given cardophyllin and continuous oxygen.

16.9.49. He was very breathless and he died.

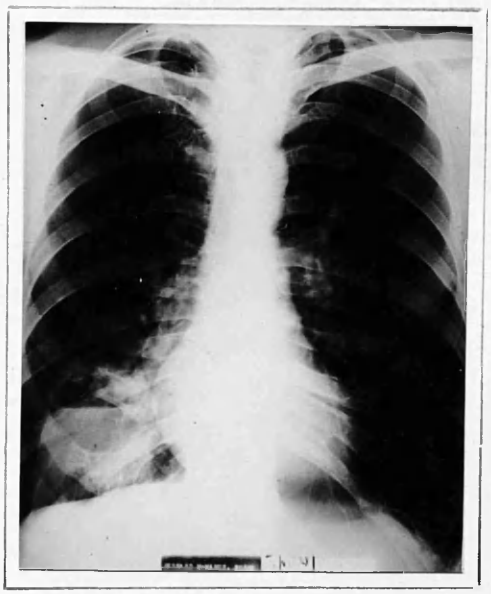


Fig. No. 216. The tumour lies in the right lower lobe; it shows central cavitation with a fluid level and there is surrounding pneumonic and atelectatic changes. There is a fair degree of emphysema as evidenced by the widely spaced ribs and depressed diaphragms.

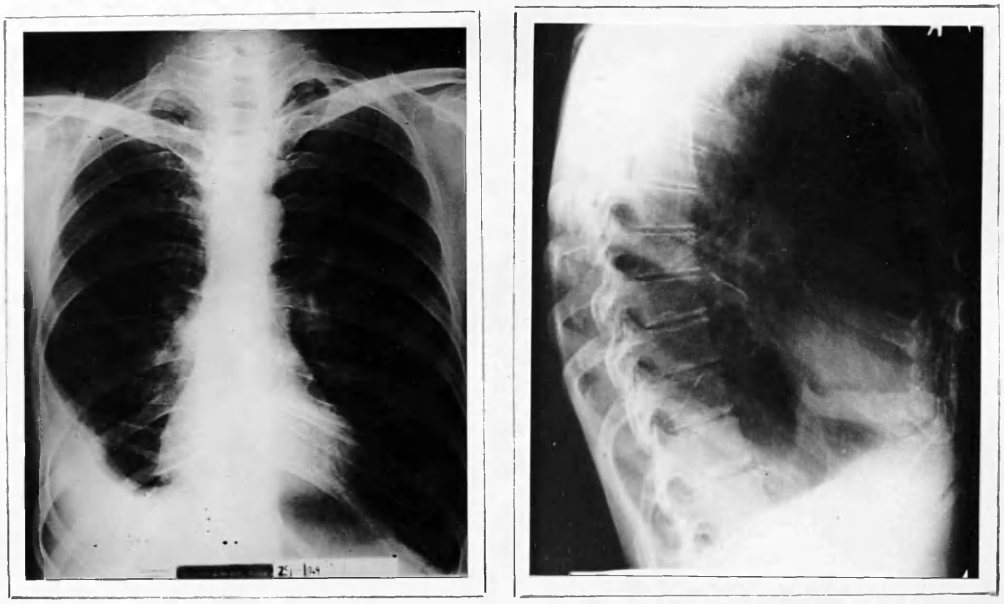


Fig. No. 217. The X-ray appearances six weeks after lower lobectomy.

Fig. No. 218. The specimen has been cut across so as to show the central degeneration in the tumour. The surrounding lung is consolidated. The invasion of the lower lobe bronchus is indicated by the white area between the cavity and the bronchi. The pleura over the diaphragmatic aspect of the tumour is greatly thickened by inflammatory changes.

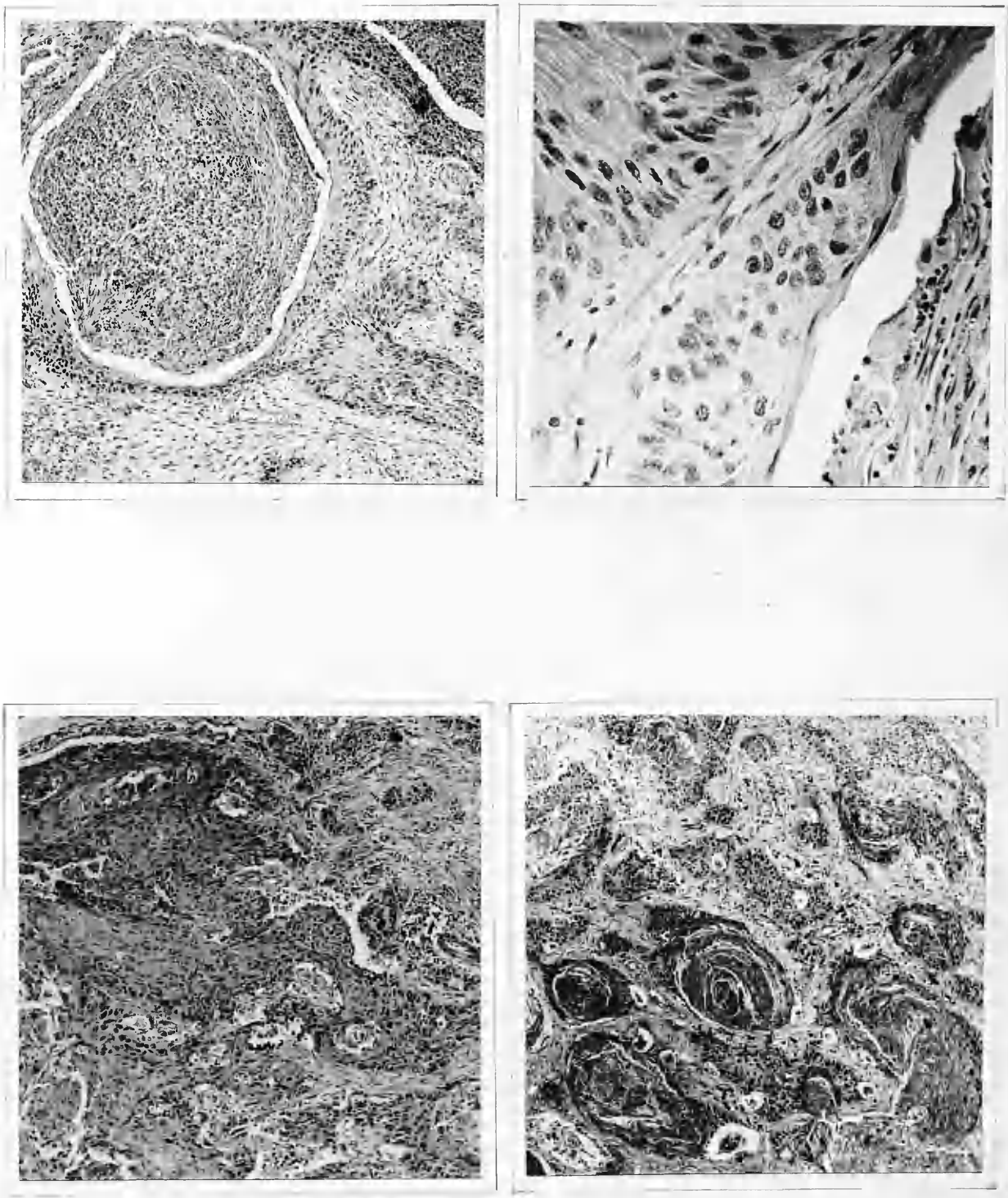


Fig. No. 219. The tumour is a fairly well differentiated squamous epithelioma. There is a moderate degree of keratinisation.

Case No. 64.

W.D. (58), Occupation - Engineer.

Admitted 24.2.49,

Dismissed 21.4.49.

Diagnosis. Bronchial carcinoma.

History. For eight months he had had a slight but persistent cough. Six months later he coughed up a small almond-sized clot of blood and for some weeks he continued to produce sputum stained with blood. He had had no chest pain and no breathlessness. On admission, he had a persistent cough with a little sputum which was flecked with blood, but he felt that his haemoptysis was less frequent than formerly and, in fact, he had had several weeks of freedom from time to time. He had had no hoarseness and no difficulty in swallowing. He had never had pain in his chest or breathlessness. His appetite had been good and he thought he had been gaining weight. He had had no previous illnesses, apart from influenza in 1918. His work involved the turning and boring of iron castings and he had worked in an atmosphere of iron dust for 40 years.

Examination. He was an intelligent, sparely built man. There was no clubbing of his fingers.

Some glands were palpable in the right axilla.
Respiratory system. Both sides of the chest moved well and the percussion note was not impaired. Vocal resonance and vocal fremitus were equal on the two sides. Bronchial breath sounds were heard over both apices and also medial to the angle of the right scapula; there were no accompaniments.
Alimentary system and central nervous system showed no abnormality.

A later examination of the respiratory system showed that there was some diminished movement of the left side of the chest. The percussion note was slightly impaired over the right side of the chest anteriorly. The respiratory murmur in this area showed some tubularity.

24.2.49. X-ray Report, Dr. McKail. "There is an area of homogeneous opacity occupying most of the posterior subapical segment of the upper lobe of the right lung. Its margins are slightly irregular but are sharply demarcated.

The appearances are probably due to bronchial carcinoma, but a chronic inflammatory process is by no means excluded".

2.3.49. Bronchoscopy, Dr. Semple. "Trachea,

carina and main stem bronchi normal. Left upper lobe bronchus - viewed through the telescope and distal orifices well seen. Right upper lobe orifice seemed to be obliterated to a slit, either by distortion or by extrinsic pressure, suggesting that the right upper lobe neoplasm is inoperable".

7.3.49. A diagnostic pneumothorax was performed; 1,000 c.c. of air were instilled. The mass appeared to be intrapulmonary.

11.3.49. Operation - Mr. Dick, Mr. Fraser. Dr. Pinkerton - Pentothal Cyclopropane Tuberin.

The right side of the chest was opened through the bed of the resected 6th rib. The lung was free, apart from an adhesion to the chest wall at the apex of the lung overlying a cavernous area in the upper lobe. The right pulmonary artery was secured, ligated and divided, as were the superior followed by the inferior pulmonary veins. The bronchus was clamped and divided. A few glands were found at the hilum of the lung which were removed, and on section, appeared to be normal. The bronchus was closed with interrupted sutures and after sprinkling with powder, the bronchus stump was closed with mediastinal pleura. A drainage tube was inserted and the chest was closed.

14.3.39. Royal College of Physicians, Pathology Report, Dr. Lees. "Two portions of tissue:-

1. This is bronchus and in the lung outside it there is a carcinoma.

2. It consists of masses of large irregular cells lying in a fibrotic reaction. There is a well marked tendency to mucous formation and a semi-glanduliform clefting of the cell masses.

3. Conformable with a primary lung or bronchial tumour.

4. The lymph nodes, or rather, aggregation of lymph nodes are not invaded".

16.3.49. Pathological Report, Mr. K. Fraser. "The specimen had been opened at the time of operation and before preservation with resultant distortion. The tumour appears to be involving the posterior segment of the upper lobe. It is 4.5 x 5.4 cm. in size and has invaded the upper lobe bronchus into which it is projecting 2 cm. distal to the origin of the upper lobe bronchus. The tumour shows two areas of central degeneration the largest of which is 1.5 cm. in diameter".

16.3.49. The drainage tube was removed.

23.3.49. His general condition was fairly good,

but he was not feeling so well to-day.

24.3.49. His sputum was stained with bright fresh blood.

25.3.49. His pulse was irregular and he was put on to quinidine.

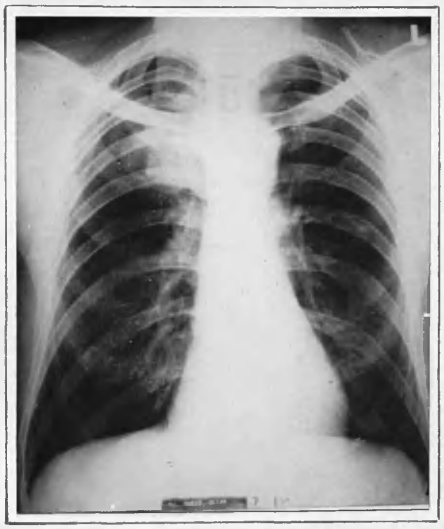
19.4.49. His pulse was now regular and his general condition was excellent.

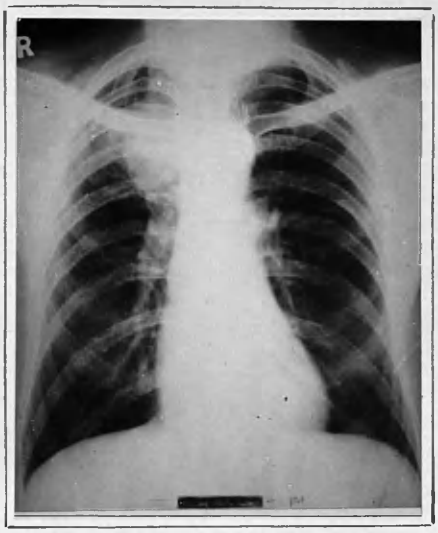
21.4.49. He was allowed home.

10.8.49. He reported as an outpatient. He had weakness in his left arm and shoulder, otherwise he was well.

10.10.50. Reported. His weight was increasing.

His doctor reported that he was well in January 1954.





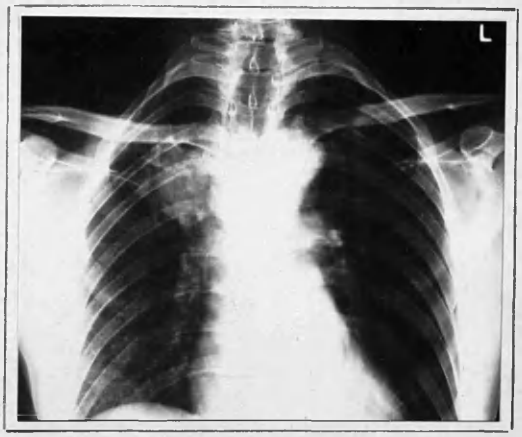


Fig. No. 220. The tumour casts a shadow in the right upper lobe. The lateral film reveals the fact that it is in the posterior division of the upper lobe bronchus. The lower right X-ray film shows greater penetration.

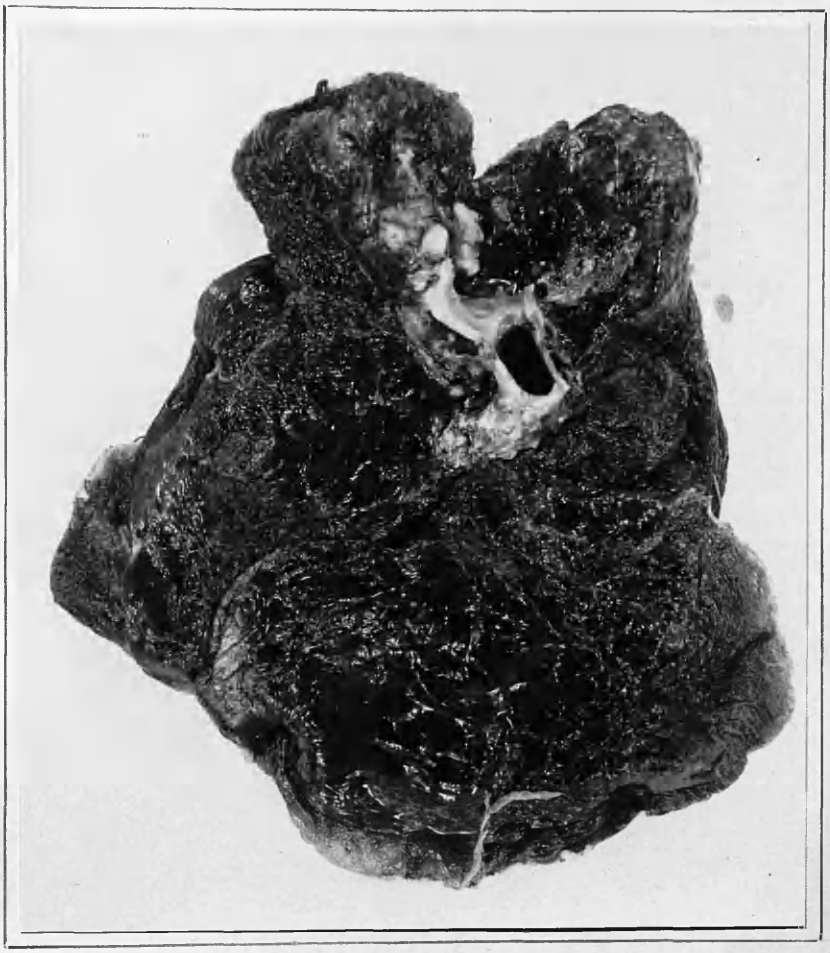


Fig. No.221. The specimen is rather distorted but the posterior division bronchus of the upper lobe can be seen exposed and unopened as it runs in a posterior direction from the opened stem bronchus. It is just possible to see the areas of central degeneration within the tumour.

Case No. 65.

J.H. (62). Occupation - Ironfounder's Representative.

Admitted 16.8.45,

Dismissed 20.9.45.

Diagnosis Bronchogenic carcinoma of right upper lobe.

History. Six months prior to admission the patient coughed up some dark brown material. Since then he had done this repeatedly. The sputum was occasionally red in colour, but was usually dark brown and sometimes like prune juice. He had had a troublesome cough, but no breathlessness. His appetite had been good, but he had been losing weight for some time. His previous health had been good.

Examination. He was a stockily built, pale looking man. There was a slight degree of cyanosis.

There was no enlargement of glands, but there was slight clubbing of fingers.

Respiratory system. The chest was of emphysematous type and moved little on respiration. The breath sounds were poorly heard and the vocal fremitus was increased in the upper part of the right lung, as was the vocal resonance in this area. There was some tenderness in the right chest posteriorly. There was some whispered pectoriloquy over this area.

18.8.45. X-ray Report, Dr. McKail. "Roughly spherical mass about 7 cms. in diameter situated in the pectoral segment of the right upper lobe. Its margins are fairly well defined and there is an irregular excavation superiorly. The mass has increased in size since 6.7.45. The appearances are those of a bronchial carcinoma".

23.8.45. Bronchoscopy, Dr. Howie. "The trachea is central. Carina central and knife edged. There is slight fullness on the posterior wall of the right main bronchus just below the carina and overhanging entrance to the upper lobe bronchus. Lower lobe bronchi are normal. Thick purulent material exudes from the upper lobe bronchus.

Conclusion - There is some pathological process in the right upper lobe producing excess of muco pus. No other evidence of disease, except fullness of the posterior wall of the upper part of right bronchus".

14.9.45. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Cyclopropane.

The right chest was opened by the usual postero-lateral incision. A large cystic tumour was found to occupy the right lung and was mainly situated

in the upper lobe, but was not confined to this area. The lung was removed and the various structures were secured and dealt with in the usual way. No drainage tube was inserted in this case.

15.9.45. The patient's condition was as good as could be expected. The chest was aspirated and 250 c.c. of blood stained fluid removed.

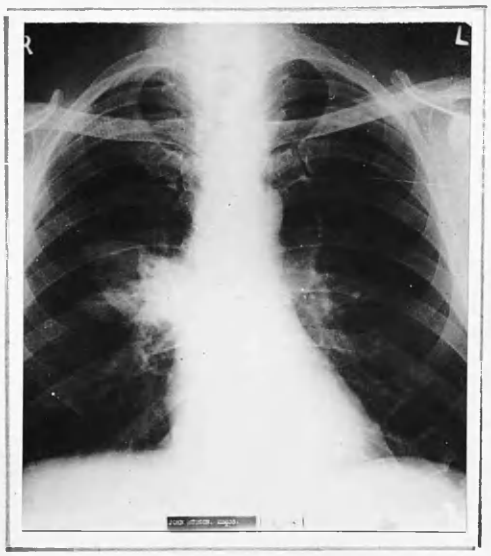
19.9.45. He had been aspirated on alternate days. Patient was taking frequent relapses and was requiring oxygen at frequent intervals but he did not take kindly to the oxygen mask.

20.9.45. He became increasingly dyspnoeic and despite administration of coramine, he died.

Pathological Report, Mr. K. Fraser. "There is a tumour $5\frac{1}{2}$ x 7 cm. in diameter involving what appears to be the anterior segment of the right upper lobe. It is greyish white in colour and shows central degeneration and haemorrhage. The lung tissue has been displaced by the tumour in such a way as to give the appearance of a false capsule. The pleura overlying the site of the tumour shows chronic inflammatory and haemorrhagic changes. There appears to be an invaded lymph gland at the hilum between the upper and middle lobe bronchi.

This is an oat cell carcinoma. There are sheets

and columns of oval and elongated small cells "streaming" in all directions. There is considerable variation in size, shape and staining quality of the cells".



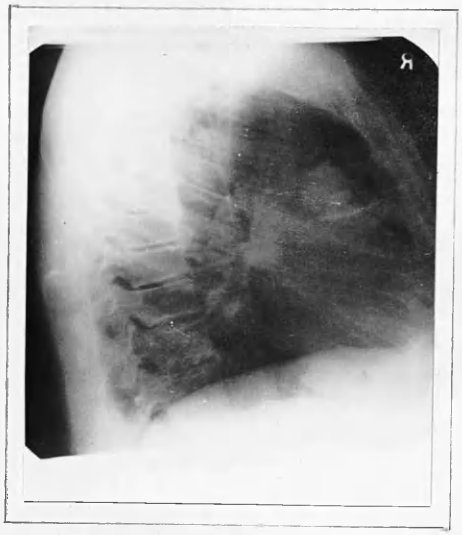
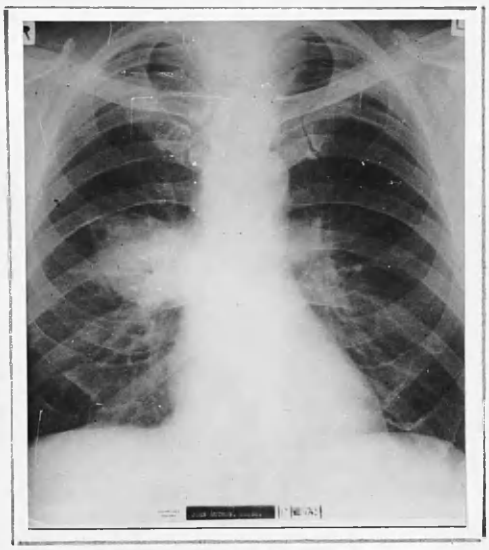
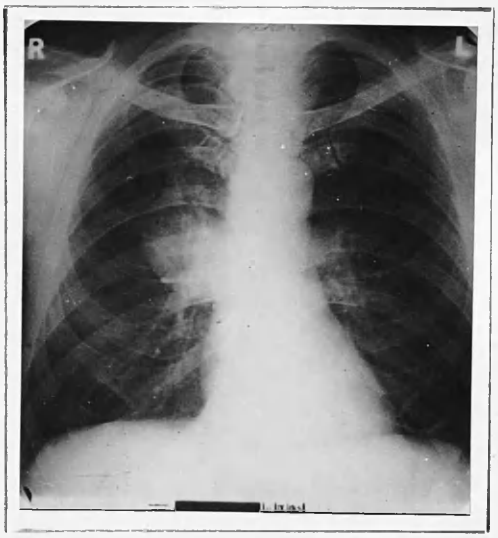


Fig. No. 222. The top photographs show the tumour lying in the anterior segment of the upper lobe. The postero-anterior view might suggest that the tumour was in the apex of the lower lobe but this idea is immediately repudiated when one looks at the lateral picture - thus illustrating again the value of lateral





x-ray films. As it happens the upward and outward extension in the postero-anterior photograph should in itself cause one to realise that the tumour is in fact in the upper lobe. The lower left photograph was taken after six weeks; the lower right one was taken after nine weeks. The tumour is now considerably larger and in the right photograph evidence of commencing upper lobe atelectasis is evident in the upward running striations.

Fig. No. 223. The lung has been cut across to show the full size of the tumour. It is lying in the anterior segment of the upper lobe. Immediately below the lobe is the horizontal fissure which separates the upper and middle lobes.

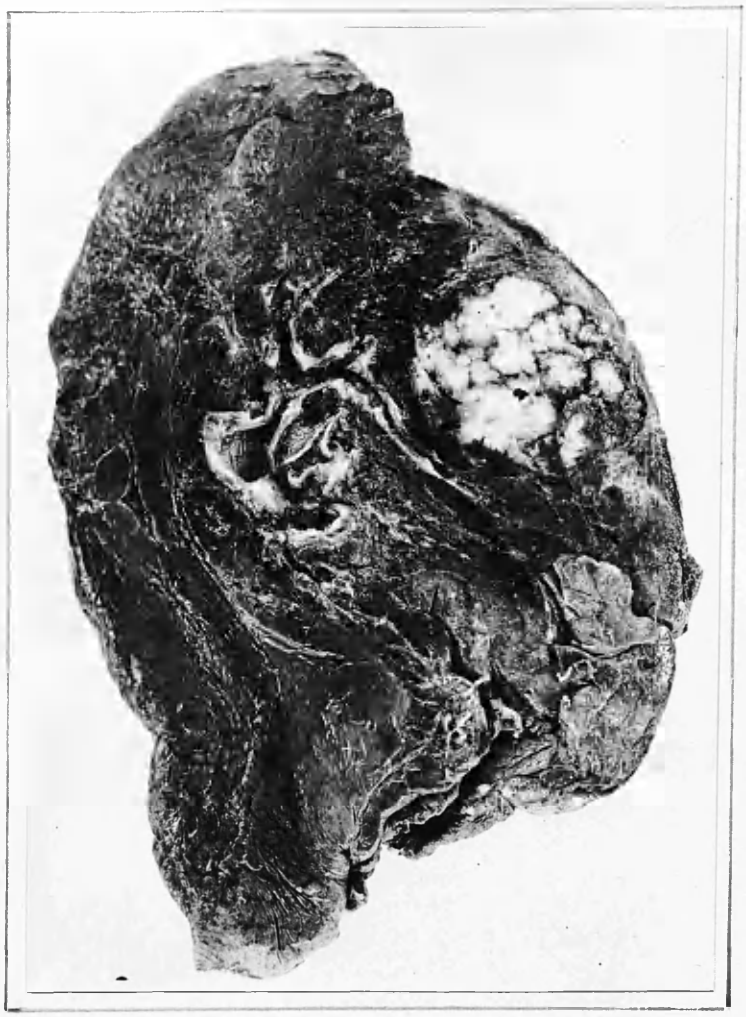


Fig. No. 224. A deeper "section" has been cut. The horizontal and oblique fissures are well seen. The stem and upper lobe bronchi have been opened to reveal the apical bronchus running upwards and the anterior bronchus running to the right; the latter divides into its main subdivisions which run above and below the tumour. In places the tumour has a false capsule of compressed lung tissue.

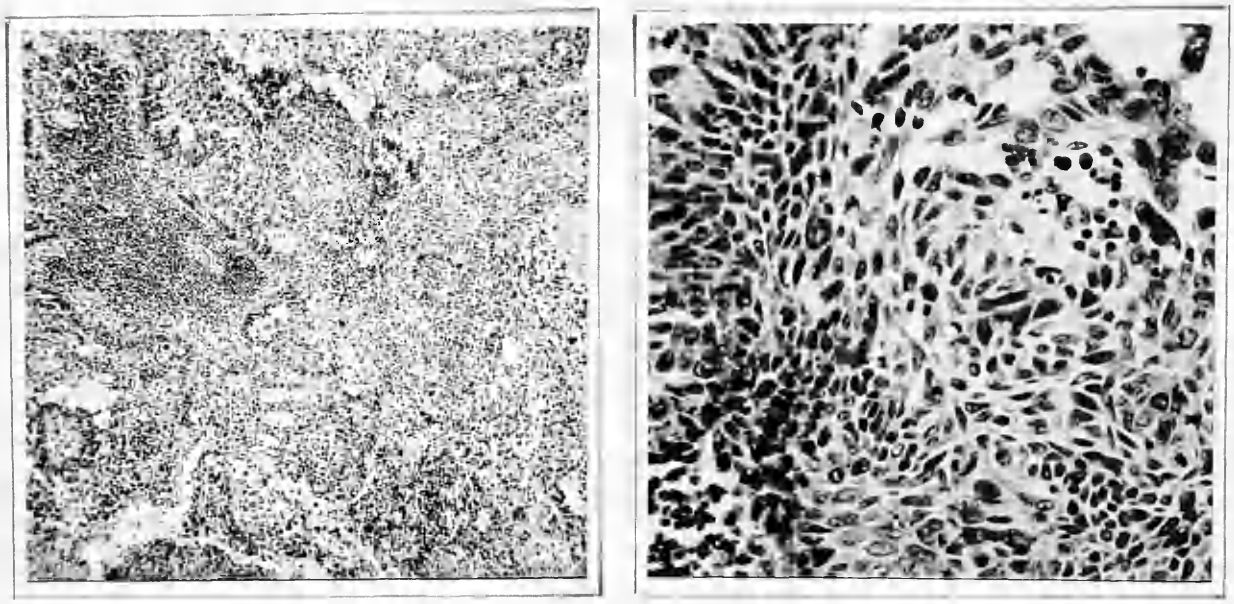


Fig. No.225. This is an oat-cell carcinoma. The cells show considerable variation in size and shape. They are "streaming" across the lung field in sheets and columns.

Case No.66.

Dr. H. (59). General Practitioner.

Admitted 13.1.48.

Dismissed 26.2.48.

Diagnosis Squamous-cell carcinoma of left upper lobe.

History. For a number of weeks before admission, there had been a sensation of uneasiness and slight pain over the left anterior aspect of the chest. Five weeks prior to admission he felt unwell and had pyrexia for one day; this was accompanied by cough and he had loss of energy, so much so that he required to retire to bed each evening when his work was done. He had had a little sputum, but no haemoptysis. His appetite had been good. Bowels were moving regularly. No breathlessness and no dysuria.

Examination. He was a pale man of fairly good nutrition. There was slight cyanosis but there was no oedema or glandular enlargement.

Respiratory system. Movement of the chest was good, apart from diminished movement over the left upper lobe. Percussion note was resonant throughout. The R.M. was vesicular and crepitations were present over the left upper lobe.

Cardio-vascular system. No abnormality.

14.1.48. X-ray Report, Dr. McKail. "There is a fairly well defined opacity projecting from the mediastinum anteriorly at the level of the junction

of the body and manubrium of the sternum. The appearance is consistent with carcinoma of thymus, or alternatively, bronchial carcinoma of left upper lobe".

A diagnostic pneumothorax was performed, and on screening after a refill, the tumour was seen to fall away from the chest wall.

27.1.48. Operation - Mr. Dick, Mr. Fraser. Dr. Pinkerton, Pentothal, Cyclopropane Ether.

A left pneumonectomy was carried out. The tumour was found on the mediastinal surface of the upper lobe and was adherent to the left side of the mediastinum. There were no enlarged hilar glands and the dissection of the lung root was quite easy. The bronchus was stitched with silk and partially buried with flaps of tissue from adjacent structures. 50,000 units of penicillin were left in the space and two drainage tubes were inserted.

On section, the tumour was found to be of some whitish tissue with a ragged cavity about 1" in diameter. The tumour was roughly 2" or 2½" in diameter.

His progress was fairly satisfactory following operation, except for the fact that he had an irritating cough.

Pathological Report - Mr. Fraser.

"There is a tumour in the apex of the left

lung about 4.5 x 3.5 cm. in diameter with an area of central necrosis and a cavity about .5 cm. across. The tumour macroscopically appears to almost reach the pleura over the apex of the lobe. The tumour proper has the typical greyish white appearance on section. The lingular branch is completely free of tumour tissue and the anterior division also appears to be free. The tumour is obstructing the bronchus to the apex of the lobe. Two enlarged black glands at the hilum of the lung are not invaded".

Histology.

Sections taken from the tumour proper show it to be a cellular type of tumour of spheroidal cell variety, the cells showing a tendency to squamous type. A few mitotic figures are seen and the tumour has a tendency to be anaplastic. Sections taken from the apex of the lung show that the tumour reaches to within millimetres of the pleura and has therefore in effect invaded the pleural surface. The tissue removed from the chest wall after pneumonectomy from the area at which the lung was adherent, shows two areas of malignant invasion.

6.2.48. The leak tube was removed.

7.2.48. He was allowed up.

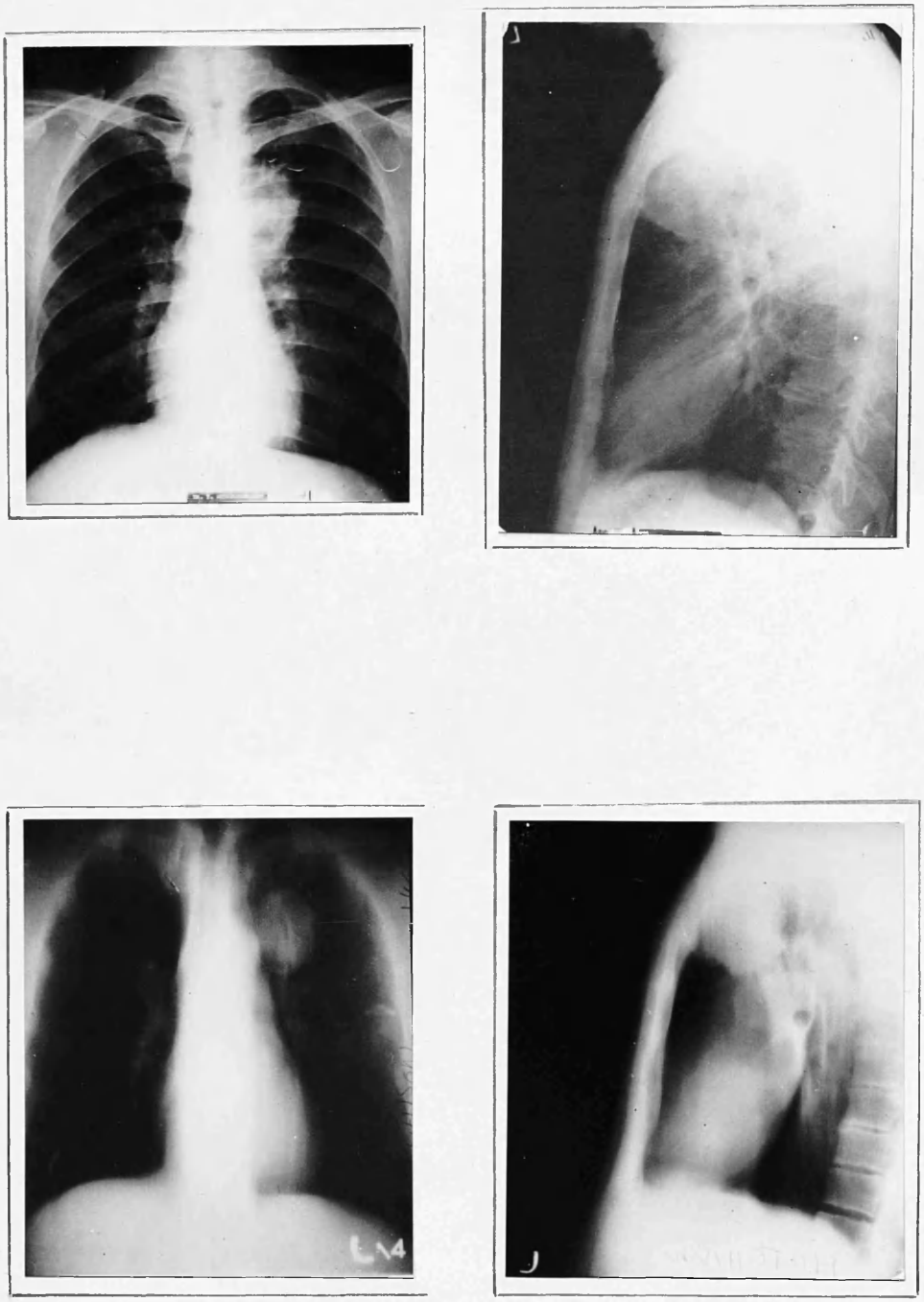


Fig. No. 226. The tumour shadow is projecting from the upper left hilar area. In the postero-anterior view a cavity due to central degeneration can be seen in the centre of the tumour. The irregular internal wall of the tumour is well seen. From these two pictures it is impossible to tell whether the tumour is in lung or thymus. The tomographs, however, reveal that it is clear of the thymus and that it is in the apical segment of the lung.

Fig. No. 227. The upper and lower lobes have been pulled apart in the upper half of the main fissure and the stem and upper lobe bronchi have been laid open. The cavitated tumour at the apex of the upper lobe has been opened into.

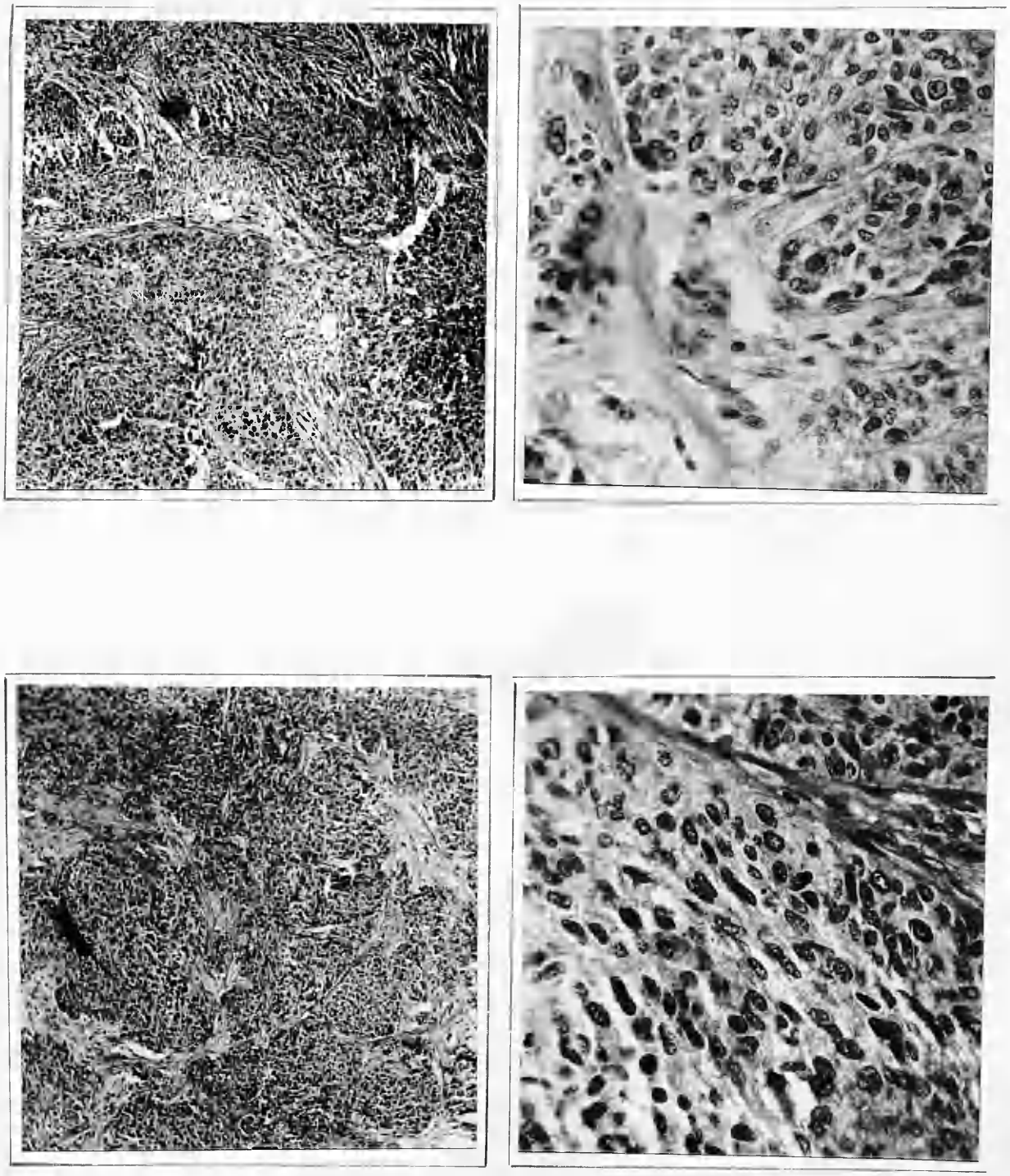


Fig. No.228. This is an undifferentiated tumour. The cells tend to be arranged in "solid alveoli".

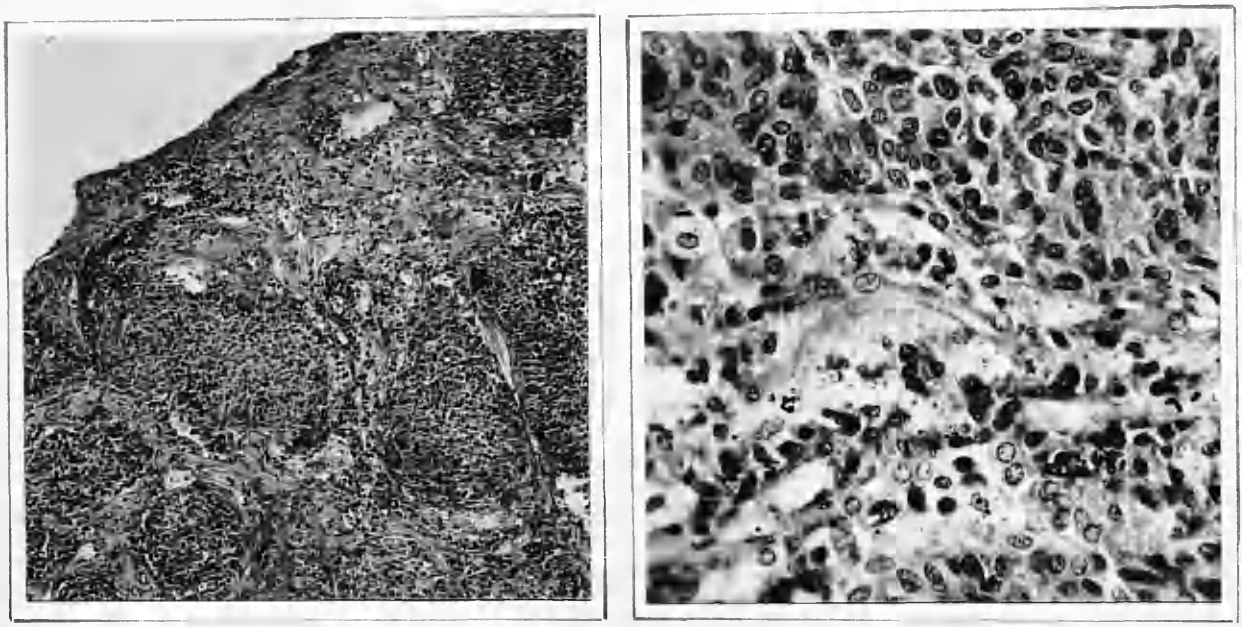


Fig. No. 229. These are photomicrographs of the pleura over the upper limit of the tumour. They show invasion of the pleura by tumour tissue.

Case No. 67.

W.K. (51). Occupation - Lorry Driver.

Admitted 12.1.46.

Died 13.2.46.

Diagnosis. Bronchogenic carcinoma right lower lobe.

History. For two years prior to admission he had had a feeling of tightness in his chest and he had had a cough accompanied by a little sputum, but no haemoptysis. He had had increasing breathlessness. He had lost two stones in weight.

Examination. He was a thin, pale man.

Respiratory system. The chest moved fairly well on respiration except at the right base, where the percussion note was impaired. Respiratory murmur was diminished and bronchophony was present. There was no enlargement of lymphatic glands to be found, and all other systems were normal.

14.1.46. X-ray Report, Dr. McKail. "Poorly defined opacity of roughly spherical shape, 8 cms. in diameter, situated in the basal portion of right lower lobe below the hilum. It is of homogeneous density. There is pleural thickening at the right costo-phrenic angle. Bronchial carcinoma of peripheral type".

17.1.46. Bronchoscopy, Dr. Howie. "Trachea central. Carina central and knife edged. Right main bronchus

free until about 1.5 cms. below the entrance of middle lobe bronchus. There is a small outgrowth from right lateral wall of lower lobe bronchus overhanging the lateral subsidiary bronchi (soft and friable); bleeds easily. Biopsy".

Conclusion - There is a tumour, probably carcinoma, in right lower lobe bronchus, blocking axillary basal divisions".

18.1.46. Histological Report, Victoria Infirmary, 91/46, Dr. Adler. "A very active reserve cell carcinoma, replacing the greater part of the tissue. The tumour contains several thin walled wide sinusoids, where the tumour cells are almost in contact with the blood stream. The tumour is very infiltrative".

25.1.46. Diagnostic pneumothorax carried out with satisfactory result.

28.1.46. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Cyclopropane.

The thorax was opened by the usual postero-lateral incision in the right chest. No adhesions were seen and the lung was removed by dissection and individual ligation of the hilar structures. Penicillin pack inserted. Wound closed.

2 pints of blood and two pints of plasma were given. Pathological Report, Mr. K. Fraser. "There is a greyish white tumour occupying the posterior area of the right lower lobe. This tumour measures 5.5 x 5 cm. and in its centre, there is some commencing breakdown, as there is in its more distal areas. The lung peripheral to the invaded area shows small abscess formation and pneumonic change. A small gland lying between the middle and lower lobe bronchi is invaded directly from tumour spread. There is submucus infiltration in the left lower stem bronchus, and deeper section of the tumour shows it projecting into the posterior division of the lower lobe bronchus. This area of tumour is .5 cm. high and occurs over an area of .5 cm. in length.

This is an undifferentiated bronchogenic carcinoma of oat-cell type. There are many thin walled vessels with tumour cells in close proximity to the blood stream".

30.1.46. Chest aspirated - 120 ccs. of blood stained fluid removed. 100,000 units of penicillin inserted. His condition was poor and he was very 'bubbly'.

1.2.46. Chest aspirated again. Marked bronchitis and pulse irregular. Restorative measures, including expectorant cough mixture, steam tent and coramine orally, were given.

3.2.46. He was much improved.

5.2.46. The pulse was now regular and of good quality.

12.2.46. This morning he developed some distress and it was suspected he might have a tension pneumothorax. A reading was taken, and it was negative. In the afternoon the distress became worse, and the reading in his chest was now markedly positive, +3/+4. 2,000 ccs. of air were withdrawn and a needle was left in situ. He had an obvious broncho-pleural fistula. Right lung now showed a very coarse R.M. and bubbling rales throughout. Pleural fluid showed b.coli.

13.2.46. He died in the early morning.

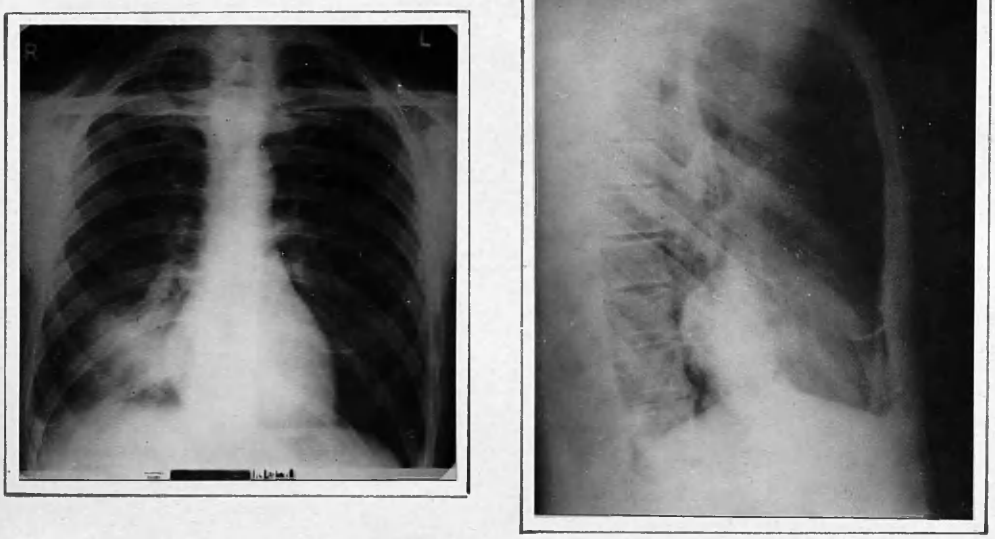


Fig. No. 230. The rounded tumour mass is visible in the right lower lobe. The lateral view shows that the tumour is involving mainly the middle segment.

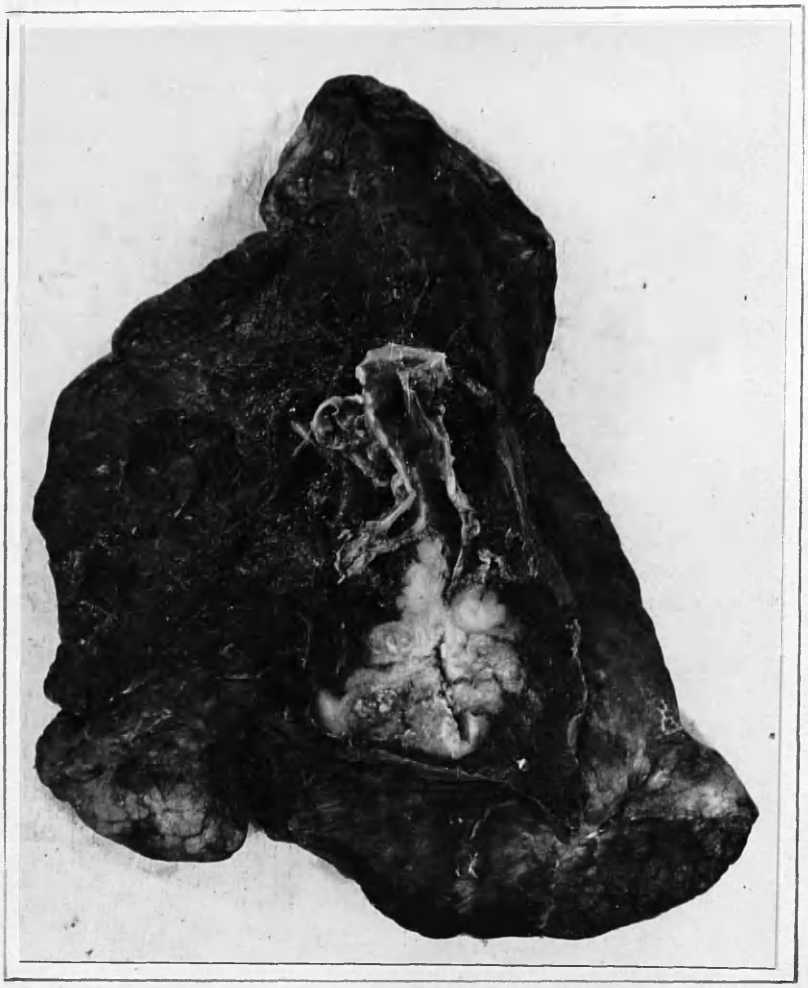
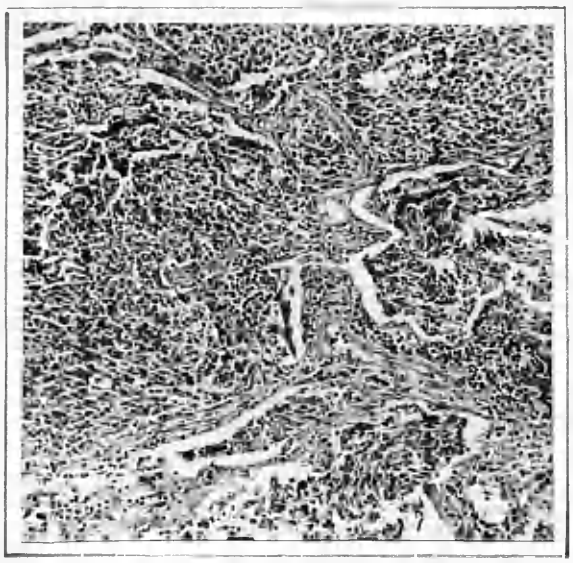


Fig. No. 231. The carcinoma involves the right lower lobe. It is 5.5 x 5 cm. in size and is occupying the middle and posterior segments of the lobe. The tumour shows central breakdown while distal to it there are pneumonic changes. Once again submucosal invasion without mucosal ulceration is evident. The opened middle lobe bronchus is seen running to the left; in the angle between the middle and lower lobe bronchi there is a lymph gland which is being invaded by direct spread from the tumour.



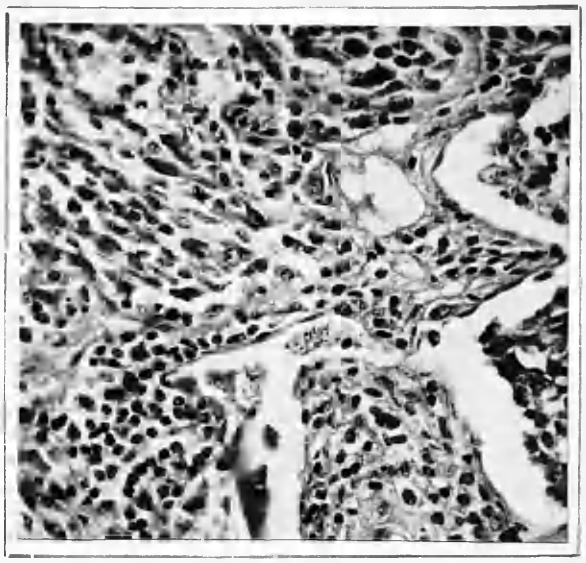


Fig. No.232. This is an undifferentiated bronchogenic carcinoma. The cells tend to be oval or spindle shaped. There is considerable inequality in the size of the cells and their nuclei. Some very thin walled vessels are present and the tumour cells are almost in contact with the blood stream.

Case No. 68.

W.L. (54). Occupation - Painter.

Admitted 6.6.50,

Dismissed 10.10.50.

Diagnosis Bronchial carcinoma.

History. In December 1949 he began to notice that he was coughing a little in the mornings and had a little purulent sputum. He also began to suffer from a tight uncomfortable feeling in the left upper chest when he exerted himself; this made him stop and rest. He had no actual pain in his chest but he was beginning to lose weight and to feel less fit than normally. In January 1950 he had an upset of a long standing gastro-intestinal complaint but this passed off in a week or two. In the few weeks prior to admission he felt that his condition had deteriorated more rapidly. He had had no haemoptysis, no hoarseness and no dysphagia.

Previous history. In 1927, and from then onwards, he had had trouble with his stomach which appeared to have been due to a duodenal ulcer.

Examination. He was a well nourished man. Mucous membranes were well injected. There was a suggestion of cyanosis about the lips. There was no oedema, no clubbing. A few lymph glands were palpable in the axilla.

Respiratory system. The chest was well developed and symmetrical. There seemed to be slight diminution of movement of the left side. There was no significant loss of resonance to the percussion note. Breath sounds were normal and there were no adventitiae. Alimentary system, cardio-vascular system and genito-urinary system were normal.

6.6.50. Bronchoscopy, Dr. Semple. "Trachea, carina and stem bronchi normal. All orifices well visualised and normal. Right upper lobe segmental orifice viewed and no tumour seen. There may be some narrowing of the segmental carina and a little bulging of the anterior wall of right upper lobe bronchus.

Conclusion - no direct evidence of neoplasm".

8.6.50. X-ray Report, Dr. Donald. "There is a relatively circumscribed opacity in the right upper lobe extending outwards from the upper end of the hilum. The appearances are almost certainly due to neoplasm. In the lateral view there are what appear to be two foreign bodies present posteriorly".

23.6.50. Operation - Mr. Fraser. Dr. Pinkerton - Pentothal, Cyclopropane, Gas & Oxygen.

The right chest was opened by resecting the 6th and

7th ribs and conserving the intervening intercostal. The lung was free of adhesions and although the tumour was bulky it was confined to the upper lobe and no glandular involvement could be detected. The mediastinal pleura posterior to the hilum was incised and after dissection the bronchus was exposed and clamped. The pulmonary artery was now isolated, ligated and divided. The superior and then the inferior pulmonary vein were similarly dealt with and the bronchus was cut across and the lung removed. A small normal looking gland lying near the carina was removed for examination. The bronchus cut close to the carina was sealed with several proximal mattress silk sutures, using an atraumatic needle, and then after removal of the terminal cartilaginous ring, a distal running silk suture completed the closure. The anterior intercostal bundle was stitched over the closed bronchus and the mediastinal pleura proximated above and below. Penicillin-sulphathiazole powder was instilled and the chest was closed with drainage.

Three and a half pints of whole blood were given during and after the operation.

26.6.50. The tube was out and his condition was satisfactory.

576/50. Royal College of Physicians Laboratory Report, Dr. Dawson. "The lung tissue - adeno-carcinoma showing considerable mucus glanduliform architecture. In other parts the tissue forms a more solid infiltrating malignant tissue with solid perivascular layout. Mitoses, frequently atypical, are easily found. The growth appears to be extending into and filling alveoli producing a growth pattern that is not easy to say is solid cancerous glands or lung alveoli secondarily filled with malignant cells. A mucine stain will be done. This report is sent now with a request for the date and reference number of the initial biopsy operation sent to us.

Mediastinal node shows no invasion by carcinoma.

The mucine stain is positive and that confirms this diagnosis of adeno-carcinoma arising from mucus glands".

1.7.50. Pathological Report, Mr. K. Fraser. "In one cut surface of the lung the tumour is seen to be greyish-white in colour, rather like gorgonzola cheese, and to be 7 x 6.5 cm. in size. It lies in the lower portion and towards the periphery of the upper lobe. On the other surface, the tumour is 3 x 3.5 cm. in diameter, is greyish-white in colour and lies at the

bifurcation of the lateral segment of the upper lobe bronchus into its subsegmental divisions. Below the bronchus and in the centre of the lower portion of the lobe there is a dirty grey area 1.75 cm. in diameter which looks like an abscess but is probably tumour tissue. There is also a gland under the angle of the upper lobe bronchus which may be invaded.

The histological picture is that of an adeno-carcinoma with abundant mucin formation".

17.7.50. Various aspirations of the chest were carried out and a trochar-cannula inserted into the right chest. 350 c.c. of sero-purulent fluid was removed and a de pezzer catheter was left in situ. The fluid was found to contain a profuse growth of penicillin insensitive coagulase positive staph. aureus. He continued to drain with three or four ounces daily, and his condition steadily improved.

18.8.50. He was put on to 1 gramme of streptomycin daily.

18.9.50. He was still running a low pyrexia with reduction in drainage.

20.9.50. His drainage increased and his temperature returned to normal.

13.5.52. He died of cerebral metastases.

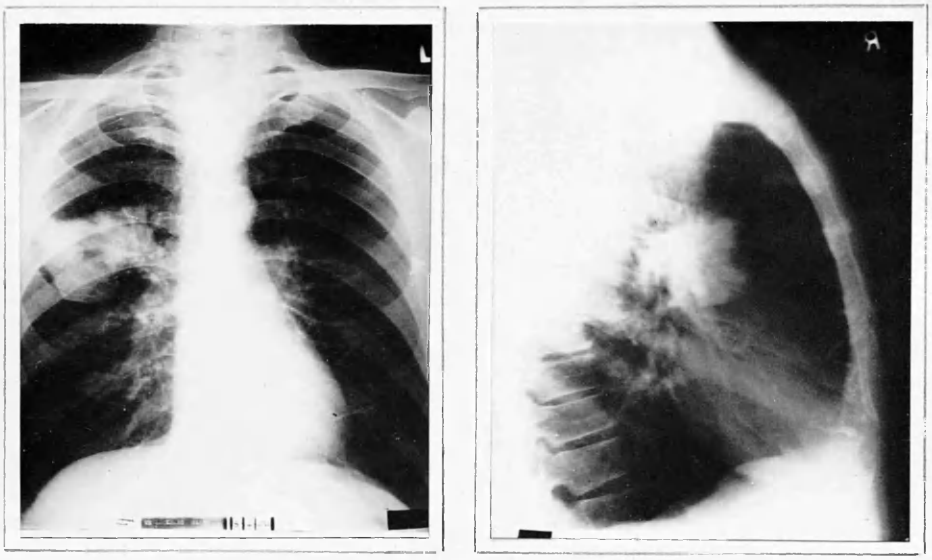


Fig. No. 233. The X-ray films show the tumour to be in the anterior segment of the right upper lobe.

Fig. No. 234. The tumour measuring 3.5 x 3 cm. is situated just distal to the point of subdivision of the anterior segmental bronchus of the upper lobe. The apical and posterior upper lobe orifices can be seen at a more proximal level in the opened bronchus. Below the tumour there is an abscess cavity filled with pus. The middle lobe bronchus is pushed downwards by the abscess.

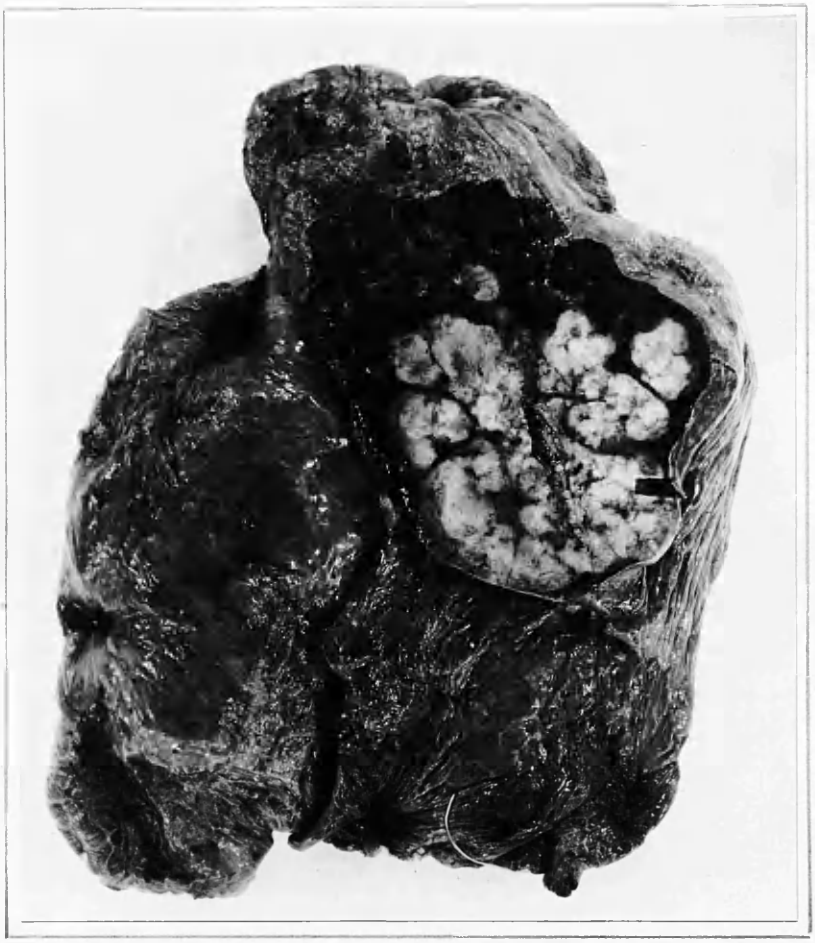


Fig. No. 235. The reverse side of the specimen which showed a gorgonzola cheese appearance in the tumour.

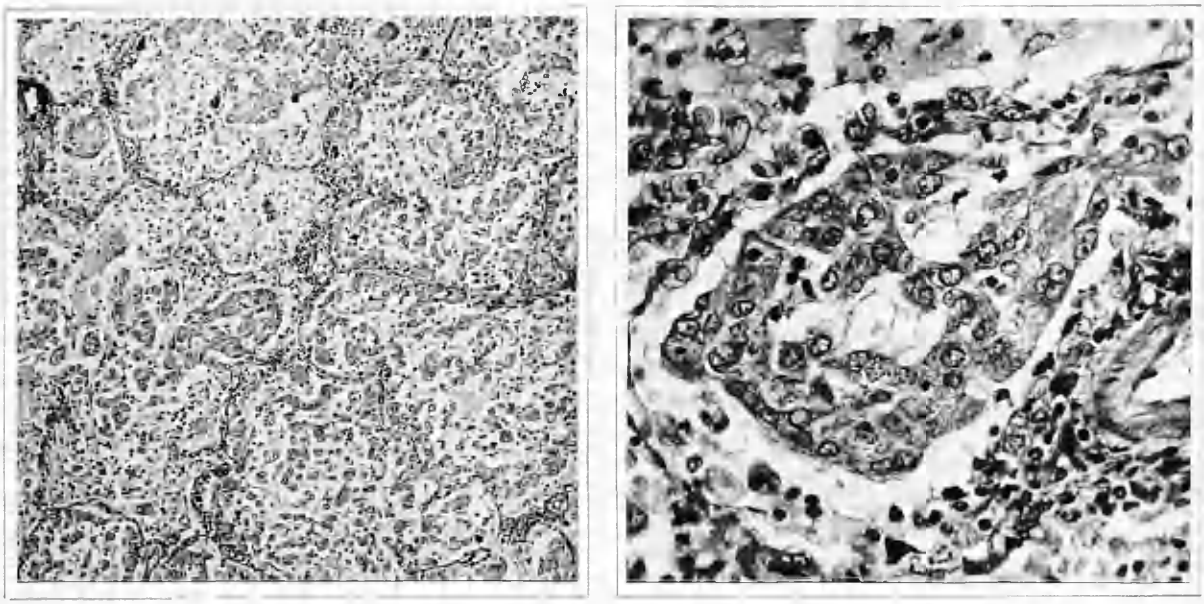


Fig. No. 236. Representative photomicrographs to show the adeno-carcinoma arrangement. There is a large amount of mucin.

Case No. 69.

D.S. (55).

Admitted 18.12.44,

Dismissed 6.1.45 (Died).

Diagnosis Bronchial Carcinoma.

History. Five months prior to admission he developed left sided pleurisy, the pain of which was present for five days. Two months prior to admission he was admitted to the Western Infirmary for complete investigation. At that time an x-ray of his chest revealed a mass in the lower lobe of the left lung with a small degree of collapse. Bronchoscopy at this time showed him to have a squamous type of carcinoma. For three months he had had a cough with some sputum; he had never had a haemoptysis. He had had no further pain in his chest. His appetite was good and he had had no loss of weight.

Examination. His condition was good. There was no evidence of loss of weight, no clubbing of the fingers and no cyanosis.

Respiratory system. There was decreased movement at the left side of the chest with decreased vocal fremitus. Percussion note at the left base was dull, where the respiratory murmur and vocal resonance were decreased.

X-ray screening showed the diaphragm to be moving, though sluggishly.

5.1.45. Operation - Mr. Dick, Mr. Fraser.

Dr. Easson -
Pentothal,
Cyclopropane.

A postero-lateral incision was used to open the left side of the chest. A small tumour about 2" in diameter was felt in the lower lobe near the hilum. A dissection pneumonectomy was carried out. First the pulmonary artery, then the bronchus followed by the pulmonary veins were ligated and divided in turn. A lymph gland was found enlarged close to and slightly adherent to the oesophagus. This was removed. The chest was closed.

Following the operation he developed gross surgical emphysema and died 10 hours later.

Pathological Report, Mr. K. Fraser. "The tumour appears to surround the main bronchus just distal to the origin of the upper lobe bronchus. It is 7.5 x 4.25 cm. in diameter. Around the bronchus the tumour is white in colour, but peripherally shows a gorgonzola appearance. The centre of the latter area shows central necrosis and haemorrhage and a cavity 2 cm. in diameter. Further section shows complete blockage of the posterior

division and also of the bronchus to the apex of the lower lobe. The gland anterior to the bronchus, that is the reverse side from the tumour, appears to have been directly invaded.

The tumour is a fairly well differentiated squamous epithelioma with a moderate number of mitotic figures".

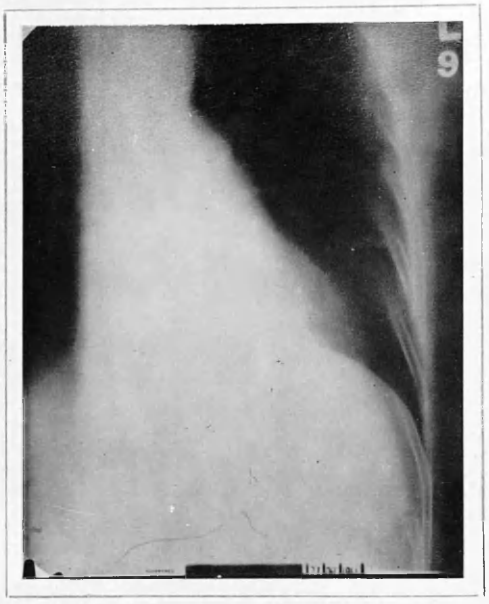


Fig. No. 237. Tomograph taken at 9 cm. from the back to show the tumour mass and the edge of the triangular shadow caused by the partly collapsed lower lobe seen through the cardiac shadow.

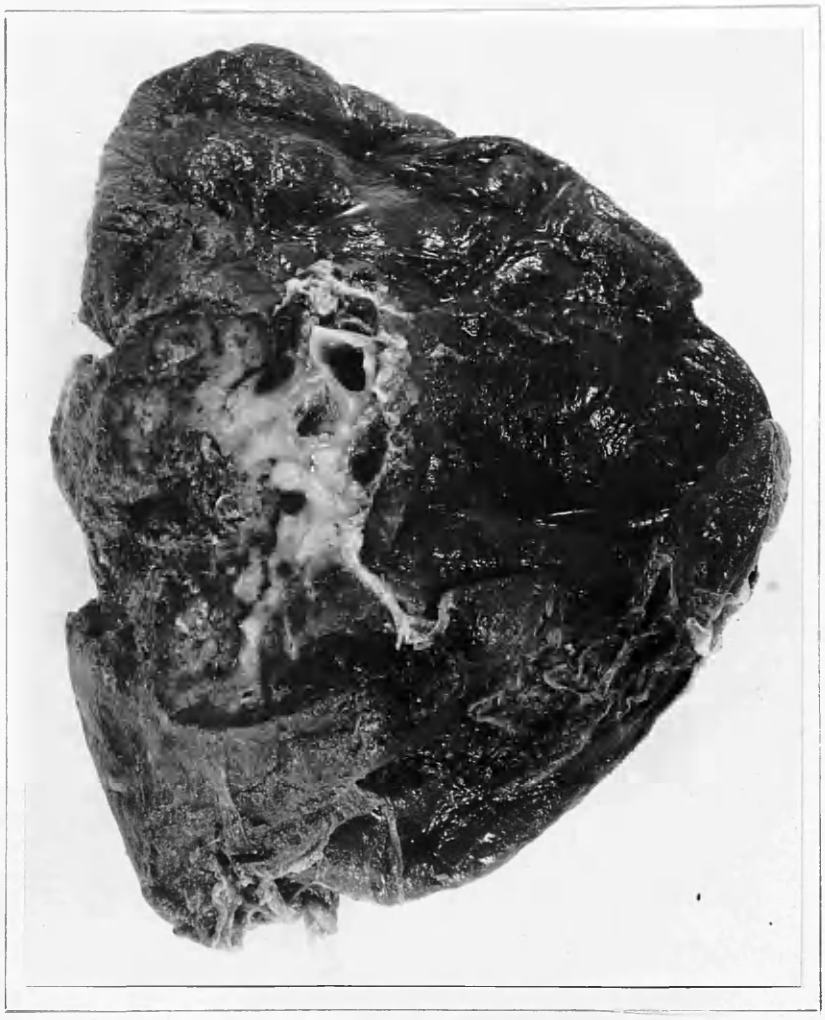


Fig. No. 238. The stem bronchus has been cut across just proximal to the upper lobe bronchus. The bronchus to the apex of the lower lobe leaves the cut bronchus at 8 o'clock while at 6 o'clock the lower lobe posterior bronchial division is seen running downwards. Both bronchi are invaded by the tumour as is a large portion of the apex of the lower lobe. The tumour measured 7.5 x 4.25 cm.

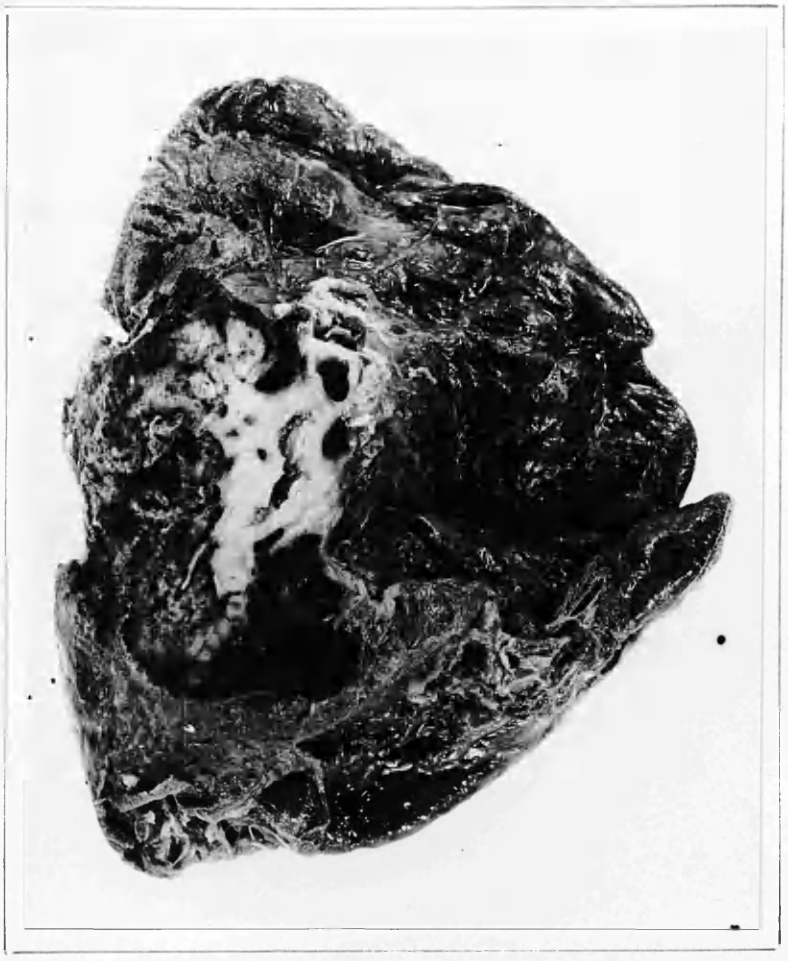


Fig. No. 239. A slightly deeper "section" of Fig. No. 238
The oval black area directly below the stem bronchus is a lymph gland.

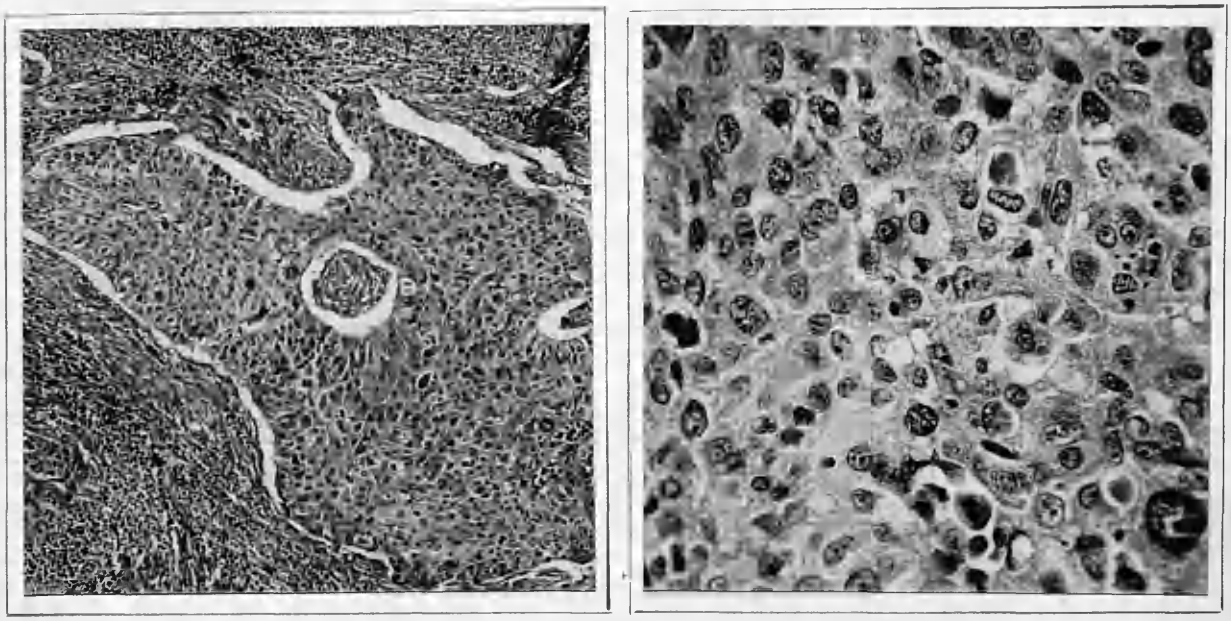


Fig. No.240. The tumour is a fairly well differentiated squamous epithelioma. A few mitotic figures are present.

Case No.70.

H.J. (55).

Admitted 10.12.45, 13.5.46, 27.7.46,

Dismissed 22.2.46. 4.7.46. 31.7.46 (Died).

Diagnosis Bronchogenic carcinoma of apex of left lower lobe.

History. Five months prior to admission he first noticed a small quantity of bright red blood in his spit. From that time the haemoptyses had been a daily occurrence. Small quantities of blood were coughed up; as the day progressed the colour of the blood changed from bright red to dark red. During these last few months the patient had been feeling well, apart from a little lassitude and undue dyspnoea on exertion. He had had a cough, with sputum, for many years. He had not lost weight. There was no upset of micturition.

Previous health. No serious illness.

Examination. A rather sallow, but well nourished patient, who showed clubbing of his fingers. There were no glands palpable in the axilla but there was slight tenderness in the left chest.

Respiratory system. The chest was symmetrical but movement over the left side was diminished. Respiratory murmur was distant and the vocal resonance was diminished. Rhonchi were heard in both sides of the chest.

11.12.45. X-ray Report, Dr. McKail. "An ill-defined ovoid opacity 8 x 6 cm. in the apex of the lower lobe of the left lung. The mass shows a cavity with irregular walls and shows a fluid level. The appearances are those of a bronchial carcinoma, with breakdown of tumour".

"Tomograph X-ray examination revealed the presence of a bronchial neoplasm, with appearances of carcinoma, which does not seem to be of the peripheral type. There is definite infiltration along the bronchus towards the left hilum. The tumour is situated in the posterior aspect of the left upper lobe, associated with some atelectasis of adjacent tissue due to obstruction. The left hilum is unduly prominent with indication of probable glandular involvement. Screen examinations show diaphragmatic movement to be present".

13.12.45. Bronchoscopy, Dr. Howie. "Trachea normal; carina central and knife edged. No thickening due to glands at the bifurcation. Right main bronchus appears normal. Left main bronchus is free; no narrowing of its lumen. Basal subsidiary bronchi clearly defined and healthy. Upper lobe and lingular bronchi visualised - no evidence of bleeding or peribronchial infiltration.

Conclusion - No frank evidence of disease in available bronchial tree".

21.12.45. Operation - Mr. Dick, Mr. Fraser.
Dr. Pinkerton -
Pentothal,
Cyclopropane.

Left postero-lateral incision. The tumour mass was found involving the upper portion of the lower lobe and there was no glandular infiltration of the hilum. The structures at the hilum were dissected out and were individually ligated and divided. Penicillin pack was inserted and the wound was closed. 2½ pints of blood were given.

Pathological Report, Mr. K. Fraser. "There is a tumour 7½ x 4 cm. occupying the apex of the lower lobe. The tumour has reached the pleural surface at one point, but does not appear to have penetrated the pleura. There is an area of central necrosis 3 x 1½ cm. in diameter. Distal lung shows pneumonic and bronchiectatic changes.

Microscopy showed this to be a rapidly growing poorly differentiated epidermoid carcinoma. The sections show much vacuolation both intra and extra-cellular. Many of the cells show complete degeneration."

25.12.45. He was very well and 250 c.c. of blood were aspirated.

28.12.45. He developed a positive pressure pneumothorax which required the insertion of a needle into the chest and the withdrawal of 400 c.c. of air. A needle with under water drainage was left in situ.

30.12.45. He developed acute bronchitis and was put into a steam tent.

5.1.46. A.P. needle was removed.

22.1.46. He was allowed up.

22.2.46. He was discharged home, well.

14.5.46. Re-admitted. Three nights previously he had had a severe bout of coughing, following which he began to bring up large quantities of very foul smelling sputum. This had persisted.

16.5.46. Theatre - Mr. Fraser. Local anaesthetic. "De pezzer catheter inserted into the empyema from which the sputum was coming.
The pus contained non-haemolytic streptococci".

28.5.46. X-ray Report, Dr. McKail - Lipiodol. "There is a leakage from the stem of the left bronchus into the left pleural cavity".

30.5.46. He complained of pain in his right thigh which had been present intermittently over the previous three months.

2.6.46. X-ray Report, Dr. McKail. "Lumbar spine - There is an area of destruction of the upper portion of the body of the second lumbar vertebra, with some collapse. There is also some collapse of the lower margin of the first lumbar vertebra.

Pelvis and Right Femur - There is an area of destruction of the shaft of the femur below the small trochanter which occupies the greater part of the diameter of the bone. These appearances are due to metastatic disease".

21.6.46. While patient was getting out of bed he felt something give way in his right leg and the leg became more painful.

21.6.46. X-ray Report, Dr. McKail. "Right femur - Pathological fracture through the tumour area with little displacement".

31.7.46. Patient suddenly collapsed and died.

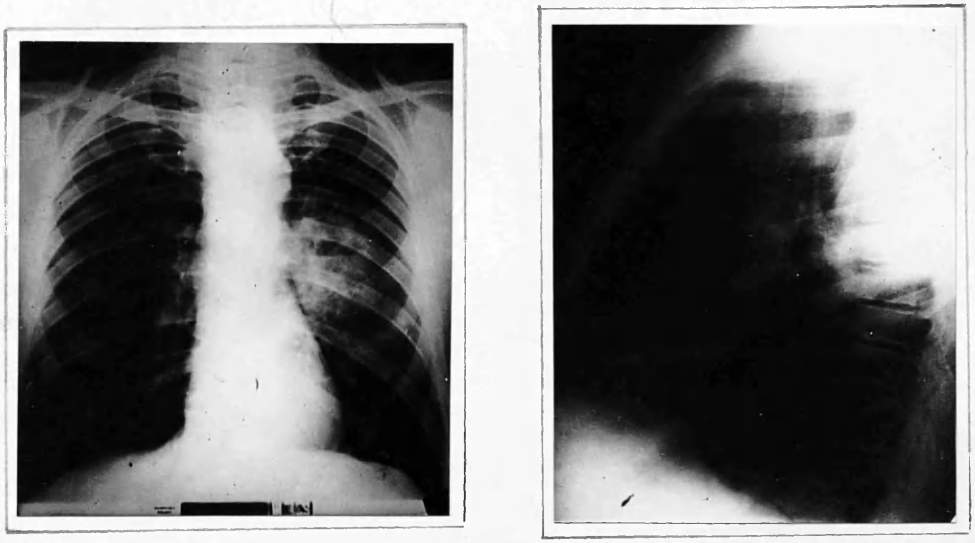


Fig. No.241. The tumour is in the apex of the left lower lobe. There is central degeneration and a fluid level within the tumour.

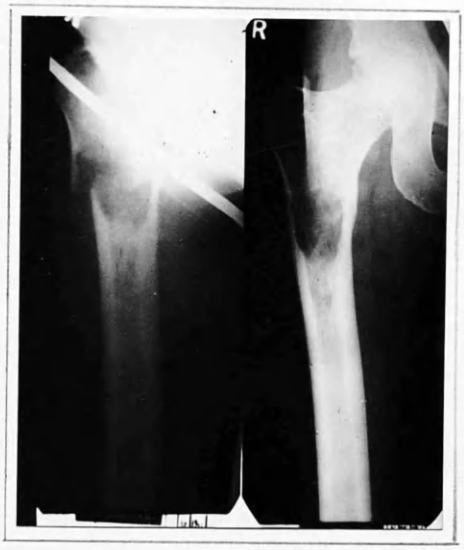


Fig. No.242. There is a metastasis in the upper end of the shaft of the right femur as shown on the X-ray photograph on the right. Later the secondary has caused a fracture as seen from the picture on the left. (The metal opacity is the ring of a Thomas splint).

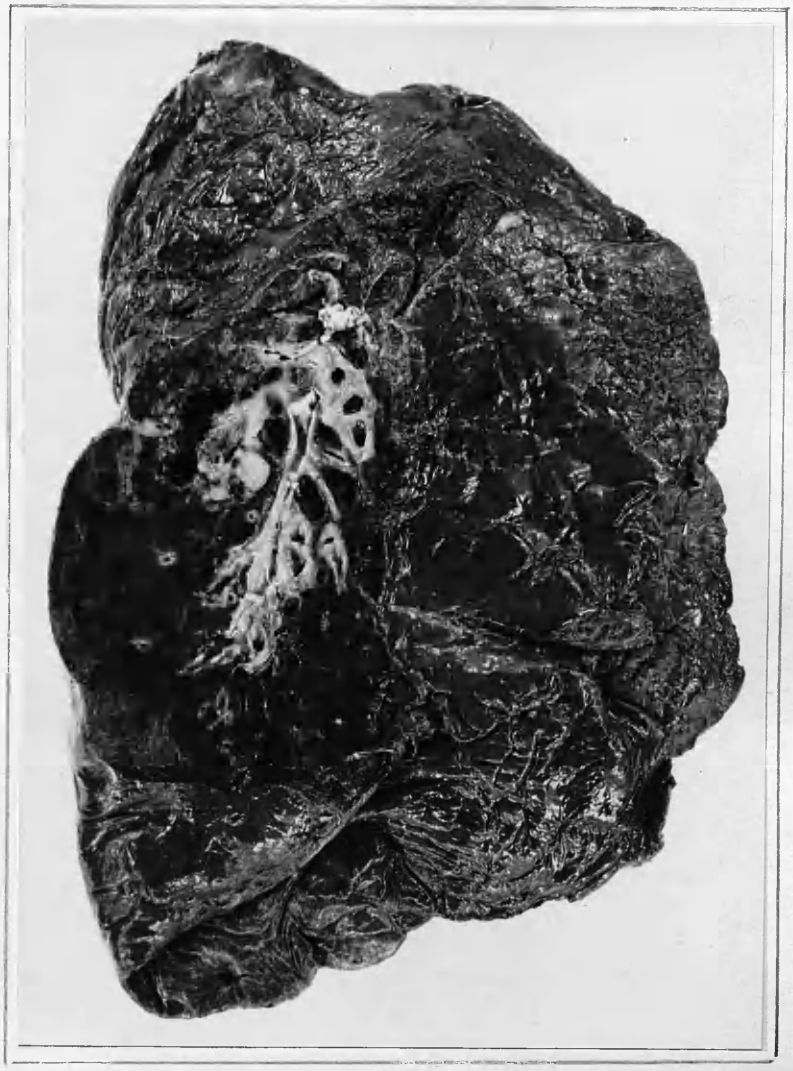


Fig. No. 243. The lung has been cut through the centre of the tumour; the latter is lying in the apex of the lower lobe. It is 7.5 x 4 cm. and the central cavitation the result of necrosis is well seen. The tumour has reached the pleura which can be seen to be pulled in towards the tumour at that point of invasion. The opened bronchus running vertically downwards is the lower lobe bronchus. The three bronchial openings above and to the right are upper lobe segmental divisions.

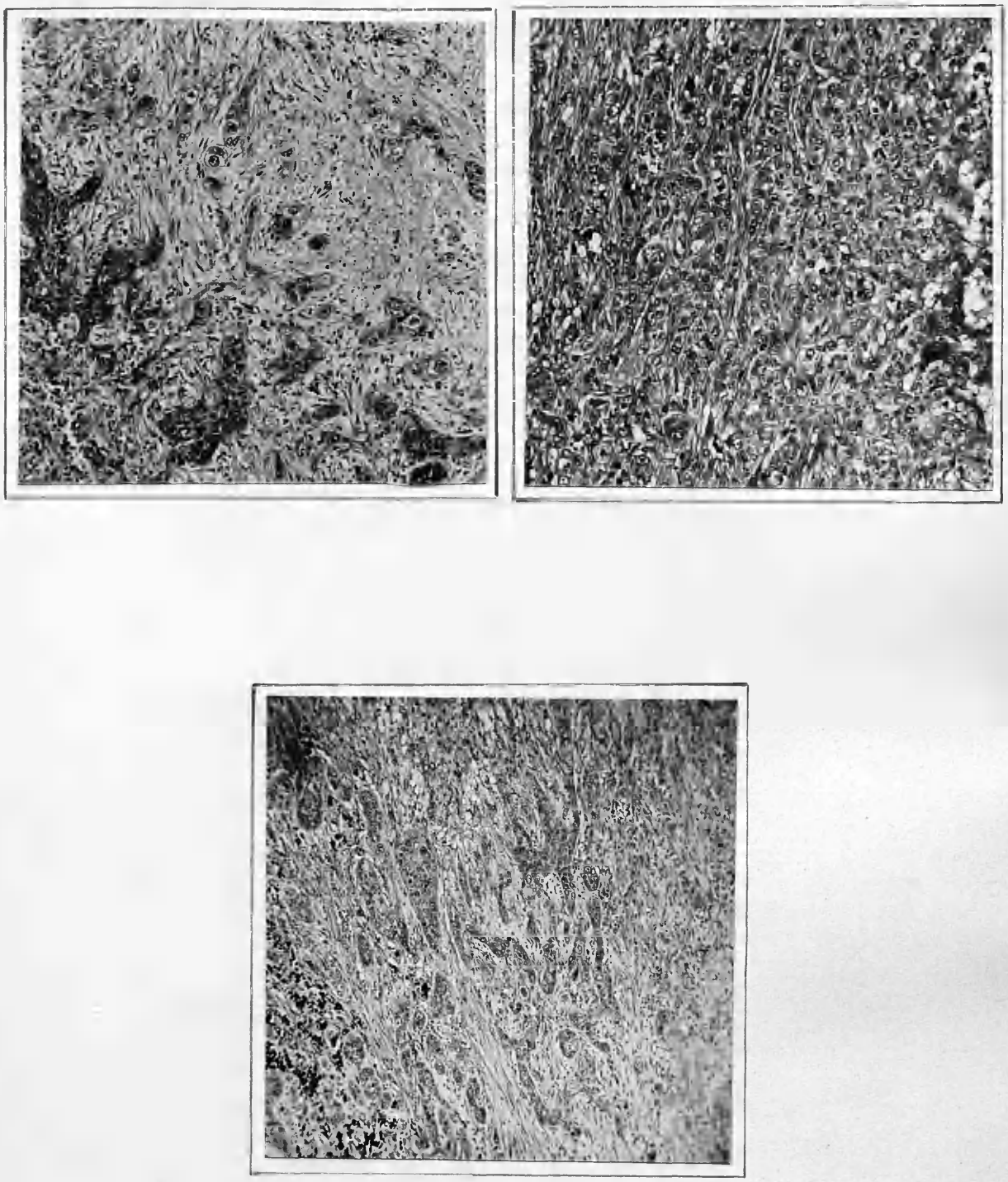


Fig. No. 244. This is an undifferentiated epidermoid tumour. There is a great deal of vacuolation of individual cells many of which are completely necrotic.

Case No. 71.

N.S. (49).

Admitted 1.8.46,

Dismissed 24.2.47 (Died).

Diagnosis Left bronchial carcinoma.

History. In October 1945 he developed bronchitis with a cough and spit and a feeling of tightness in his chest. He was in bed for three weeks and was then left with a residual cough and pink sputum mainly in the morning, which had persisted when he brought up a small amount of pinkish white sputum. Since then he had had a more or less constant dull pain in the left chest which had been absent the three days preceding admission. Nine weeks prior to admission he had had an attack of weakness with vomiting and haemoptysis. He had had no further attacks since. He had lost about 2 stones in weight but had experienced no loss of appetite.

Examination. He lay comfortably in bed.

Respiratory system. There was diminished movement at the left base; here the percussion note was dull. Expiration was prolonged and the respiratory murmur was diminished. Numerous coarse rhonchi were heard at the left base.

8.8.46. X-ray Report, Dr. McKail. "Ill-defined

opacity at the left hilum about 7 cm. in diameter. There is partial atelectasis of the lower lobe of the left lung. The mediastinal structures are displaced to the left and there is pleural thickening at the left costo-phrenic angle.

The appearances are those of bronchial carcinoma".

9.8.46. Operation - Mr. Dick, Mr. Fraser.

Dr. Sinclair - Pentothal, Cyclopropane.

The left chest was opened by a postero-lateral incision. The tumour was found to lie fairly close to the hilum and glands were found adherent to the superior pulmonary vein.

The pulmonary artery and bronchus were cleared and tied. The inferior vein was then dissected out and ligated. The superior vein was short and the pericardial sac required to be opened to obtain wider access; the vein was tied and divided.

The gland high up in the bronchus was removed. De pezzer catheter was inserted in the anterior axillary line; penicillin was instilled and the wound was closed.

12.8.46. He blew his bronchus but was stabilised satisfactorily.

14.8.46. There was some serous discharge and air

from the lower end of his wound. Culture grew B.coli and staph.aureus.

12.9.46. He had now been up for one hour a day for one week, although his wound was still leaking.

2.12.46. Operation - Mr. Fraser. Rib resection and drainage of empyema.

5.2.47. X-ray screening. "The x-ray film showed carcinoma in the upper zone of the right lung".

24.2.47. He became progressively weaker and died this morning.

Pathological Report, Mr. K. Fraser. "The cut section is distal to the origin of the upper lobe bronchus. This shows the tumour to surround the upper and lower lobe bronchi. It is 5 x 4 cm. in diameter. The tumour has invaded both bronchi and is ulcerating into the lumen of each. The lingula bronchus is blocked at one point. The tumour is mainly white in colour. One gland above the upper lobe bronchus shows direct invasion.

This is a poorly differentiated squamous epithelioma. There is a marked degree of pleomorphism and many mitotic figures".

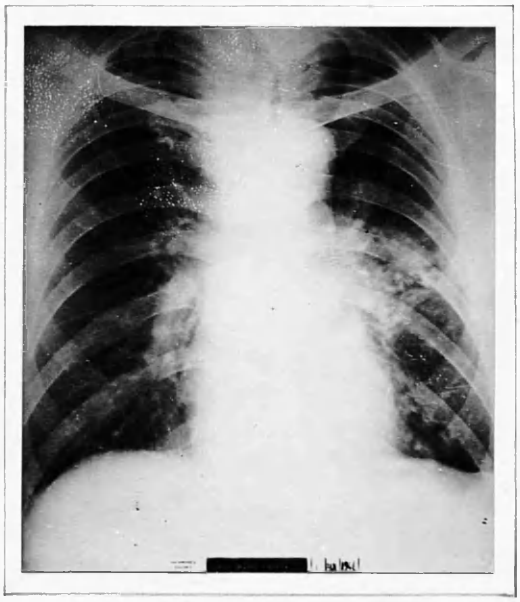


Fig. No. 245. The tumour is seen as an ill-defined shadow at the left hilum. There is some collapse of the left lung as evidenced by the retraction of the heart and mediastinum to the left.

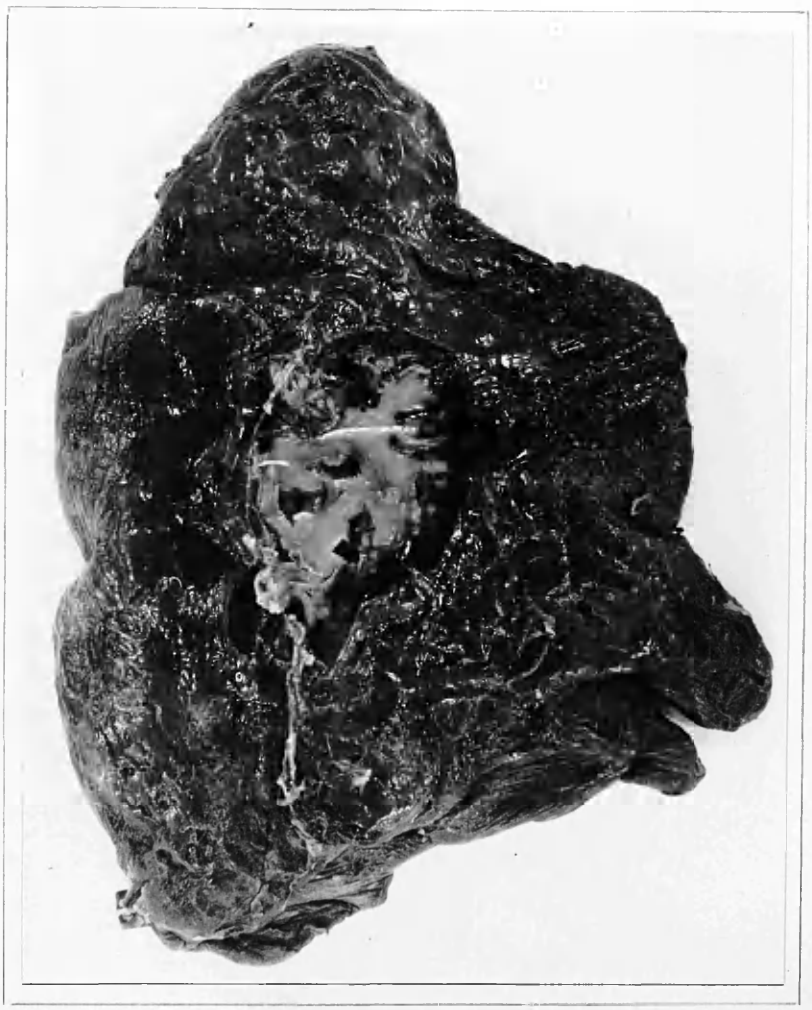


Fig. No.246. The tumour is seen to involve the upper and lower lobe bronchi. It has ulcerated into both.

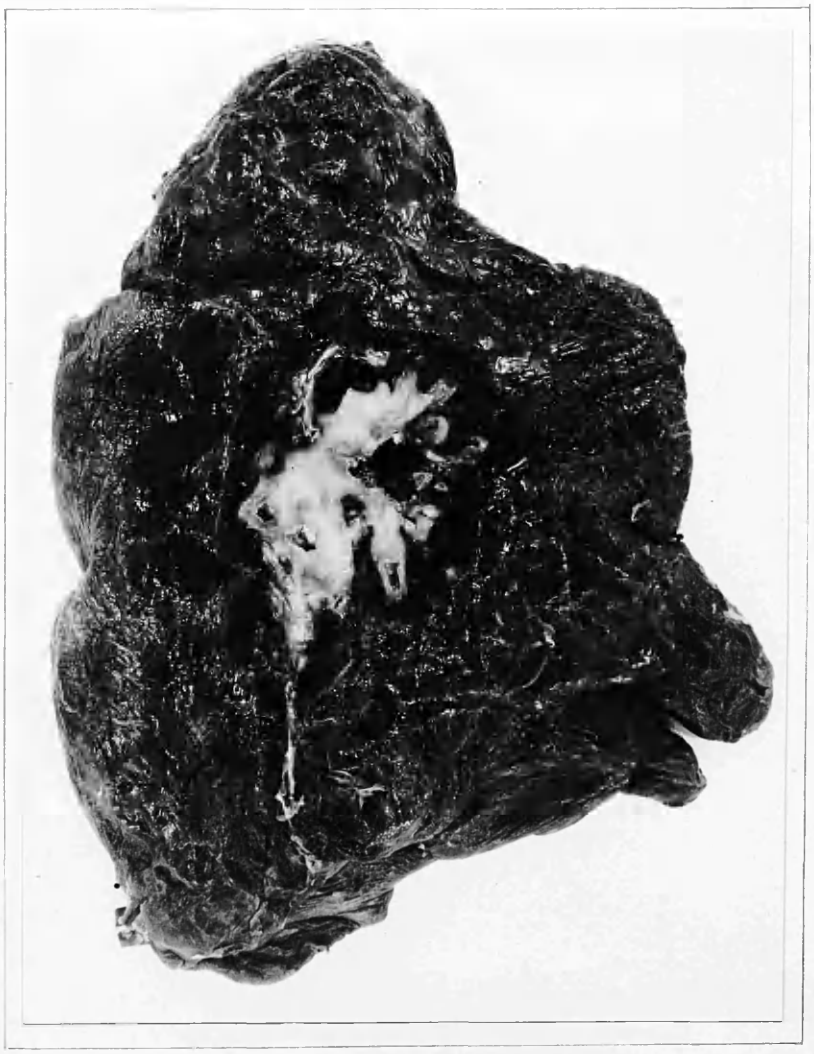


Fig. No. 247. A slightly deeper "section" of the same specimen. The tumour was 5 x 4 cm. One lymph gland above the upper lobe bronchus is invaded by direct spread.

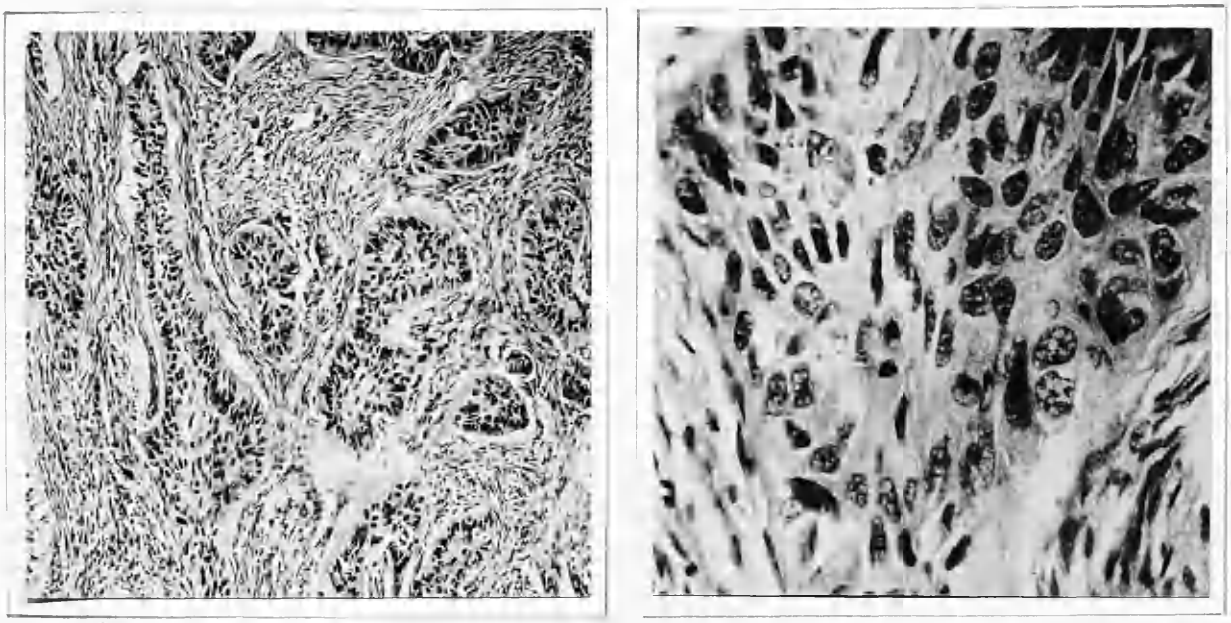


Fig. No. 248. This is an undifferentiated squamous epithelioma showing marked pleomorphism and numerous mitotic figures.

Case No. 72.

M.A . (43). Occupation - Secretary.

Admitted 8.5.52,

Dismissed 7.6.52.

Diagnosis Bronchial carcinoma.

History. In February 1952 she was off work for three weeks with bronchitis. She was x-rayed at this time and told that she had an unresolved pneumonia. One week later she developed severe pleuritic pain and a swinging temperature. After three weeks of continued pyrexia and pleuritic pain she was admitted to the Western Infirmary and again x-rayed. The x-ray films were reported as showing unresolved pneumonia. She was sent home. The chest pain continued and three weeks later the fever recurred. As she did not respond to penicillin therapy she was re-admitted to the Western Infirmary on 18.4.52 with swinging temperature and severe pain in the chest. There had been one haemoptysis. She had lost one stone in weight. She had a hoarse dry cough but very little sputum. X-ray examination showed a collapse of the right lower lobe. She was seen by Mr. Fraser who advised bronchoscopy in case the condition was due to tumour. The presence of tumour was confirmed.

Examination. She was a tall, well built woman. There was no clubbing of the fingers. There was one enlarged gland in the right axilla.

Respiratory system. The chest was symmetrical. There was poor expansion of the right side. The percussion note was dull over the right side posteriorly and the lower third anteriorly. These areas showed a diminished respiratory murmur which tended to be tubular in character. There were no respiratory accompaniments.

12.5.52. X-ray Report. "There is crowding in the lower vascular markings of the right lower lobe and the impression is gained of a mass related to anterior lower lobe bronchus. Mediastinal - intralobar effusion and effusion within general pleural cavity defined".

14.5.52. Bronchoscopy, Dr. Semple. "Trachea and carina normal. In the right lower lobe bronchus at the level of the middle lobe there is a large pink mass which was removed in toto. This had the appearance of granulating tissue or necrotic tumour. Further down in the right lower lobe bronchus was seen a pink mass of which biopsy was taken".

This tumour tissue was reported as oat-cell carcinoma.

10.5.52. Operation - Mr. Fraser.

Face down position. Right side of chest opened in usual way and right pneumonectomy performed.

Pathological Report, Dr. Davies. "The lung weighs approximately 500 g. In the lower lobe and quite close to the hilum there is a circumscribed mass of firm tumour tissue, the cut surface of which measures about 40 mm. in both vertical and transverse diameters. On its upper aspect the tumour envelops anthracotic lymph nodes which it appears to have invaded. Distal to the tumour, and running out to the pleura, there is a zone of bronchiectasis 30 mm. wide.

The microscopical appearances are those of an oat-cell carcinoma. The tumour cells occur in solid masses without any attempt at an orderly arrangement. The cells are fairly uniform in size with scanty faintly eosinophilic cytoplasm and nuclei in which the chromatin is fine and reticulated. No mitoses were found in ten unselected x 360 fields. A very occasional cell is much larger than the average and in some areas multi-nucleate cells are fairly frequent but these latter obviously originate from a degenerative process. Apart from these cells degenerative changes are slight, except towards the hilum where invasion of the lymph nodes has been followed by haemorrhage and fibrosis. Elsewhere, the tumour is well nourished by numerous little blood capillaries.

At the periphery of the tumour bronchiectasis and emphysema are established and a subacute pneumonitis with frank pyogenic foci is present".

The patient made a satisfactory recovery and was discharged home on 7.6.52.

She died from malignant secondaries five months later.

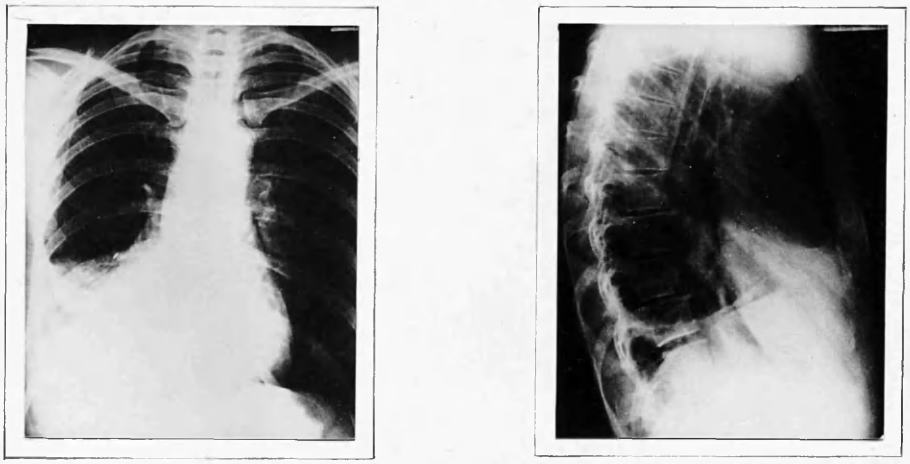


Fig. No.249. The X-ray films show collapse and consolidation in the right lower and middle lobes, there is resultant elevation of the diaphragm and displacement of the mediastinum to the right. The lateral view shows the triangular shadow of the consolidated and collapsed middle lobe; the upper surface of the lobe is displaced downwards due to the compensatory emphysema of the upper lobe.

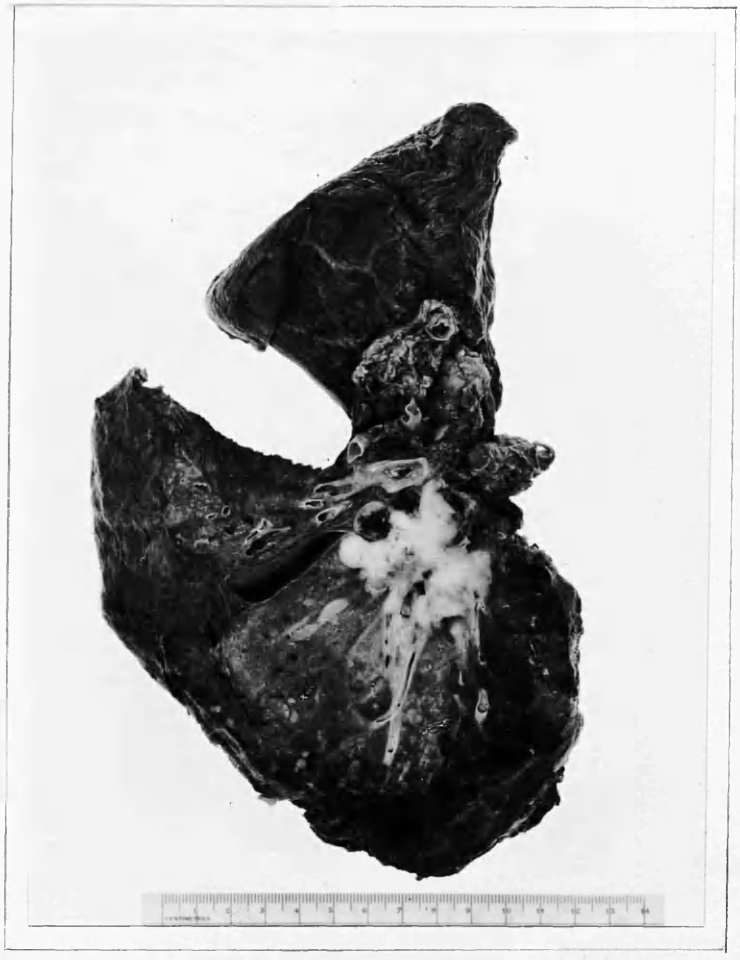


Fig. No.250. The greyish white tumour tissue is well seen as it surrounds the subdivisions of the lower lobe. The lower and middle lobes show areas of bronchiectasis.

Case No.73.

O.M. (54). Occupation - Retired.

Admitted 9.11.45, 8.8.46.

Dismissed 3. 1.46, 9.8.46.

Diagnosis Squamous epithelioma of left upper lobe.

History. He had been perfectly well until July, when he developed an attack of pneumonia. This was followed some weeks later by a similar attack. Since then he had felt fevered and had had a feeling of slight discomfort at the base of his left chest but he had had no pain. On two occasions he had coughed up bright red blood, and on other occasions he had brought up some dark clotted material. He had had a cough for many years and this had lately produced some mucoid sputum. He had lost some weight, and had some dyspnoea on exertion.

Previous Health. Malaria, enteric fever and dysentery.

Examination. He was a large, florid, well built man of good general condition. There was slight cyanosis and moderate clubbing of the fingers.

Respiratory System. His chest was symmetrical and moved evenly and well. There was dullness to percussion on the left side towards the apex at

which there was broncho-vesicular breathing, and where the respiratory murmur was diminished. V.R. and V.F. were also diminished over this area.

12.11.45. X-ray Report, Dr. McKail. "There is an area of homogeneous density involving the posterior basal segment of the left lower lobe, with enlargement of the left hilum. The margins of the opaque area are ill-defined and there is some associated atelectasis. (Lipiodol obscures the picture to some extent). Appearances are those of either a primary hilar carcinoma, with a metastatic lesion in lung; or vice versa".

13.11.45. Diagnostic pneumothorax; 700 c.c. of air instilled. X-ray, Dr. McKail. "Considerable collapse of lung obtained".

20.11.45. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton - Pentothal, Cyclopropane.

Left postero-lateral incision. A fairly large tumour was felt in the left lower lobe and some enlarged glands were felt near the hilum. The structures at the hilum were dissected out, ligated and divided individually. The adhesions to the lung were divided and the lung was removed. Penicillin

was instilled and a pack was passed to the hilum; a drain was inserted and 1,000 c.cs. of air withdrawn. During the operation, and thereafter, 2 pints of blood were given.

21.11.45. He was remarkably well.

5.12.45. Very well now and was up and about.

3.1.46. Dismissed well; to report in one month.

Pathological Report, Mr. Fraser.

"There is a polypoidal mass of tumour tissue projecting into the stem bronchus in a proximal direction to a height of 2 cm. This tumour appears to arise from the bronchus to the apex of the lower lobe, and has blocked completely the lower lobe bronchi. The lower lobe is completely replaced by areas of pneumonia, bronchiectatic changes and abscess formation. The pleural surface shows the appearances of acute inflammation. Deeper section of the lung shows the tumour to be 3.5 x 2.5 cms. There is an obviously invaded gland above the stem bronchus and a similarly invaded gland on the lower lobe bronchus.

Histology.

This is a rather poorly differentiated squamous epithelioma of alveolar type, the cells of which are arranged in sheets and columns, with a

marked amount of fibrosis. There is some invasion of lung alveoli and a marked number of mitotic figures. The lymph glands show only invasion of the lymphatics with cancer cells, otherwise there is no invasion of the gland per se, although it shows what probably has been old tuberculosis.

The entire lower lobe shows a picture of bronchiectasis, abscess formation and unresolved pneumonia.

The above histology was kindly seen by Dr. Lendrum, who confirmed the pathological findings".

8.8.46. He had been very well until to-day, when he suddenly developed a hemiplegia, probably from cerebral metastases.

9.8.46. He died to-day.

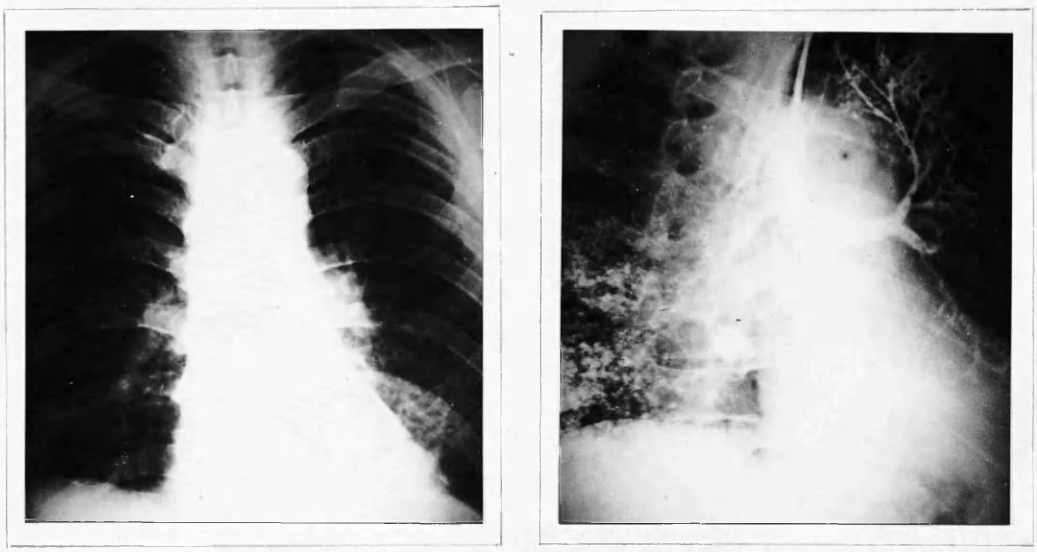


Fig. No. 251. The postero-anterior view shows the tumour mass in the left hilar area; some atelectasis and associated bronchiectasis can be seen in the left lower lobe. The photograph on the right shows an oblique view of a bronchogram in this case. The left upper lobe is well filled in all its segments with the exception of the lingula. The lower lobe is not filled at all. At the point at which the lower lobe bronchus should have origin from the stem bronchus there can be seen a filling defect in the lower edge of the lipiodol; this is due to a projection of tumour tissue into the bronchial lumen at this point. The right half of the x-ray is reproduced quite accurately in the bronchial outlines of the cut specimen (Fig. No. 252).

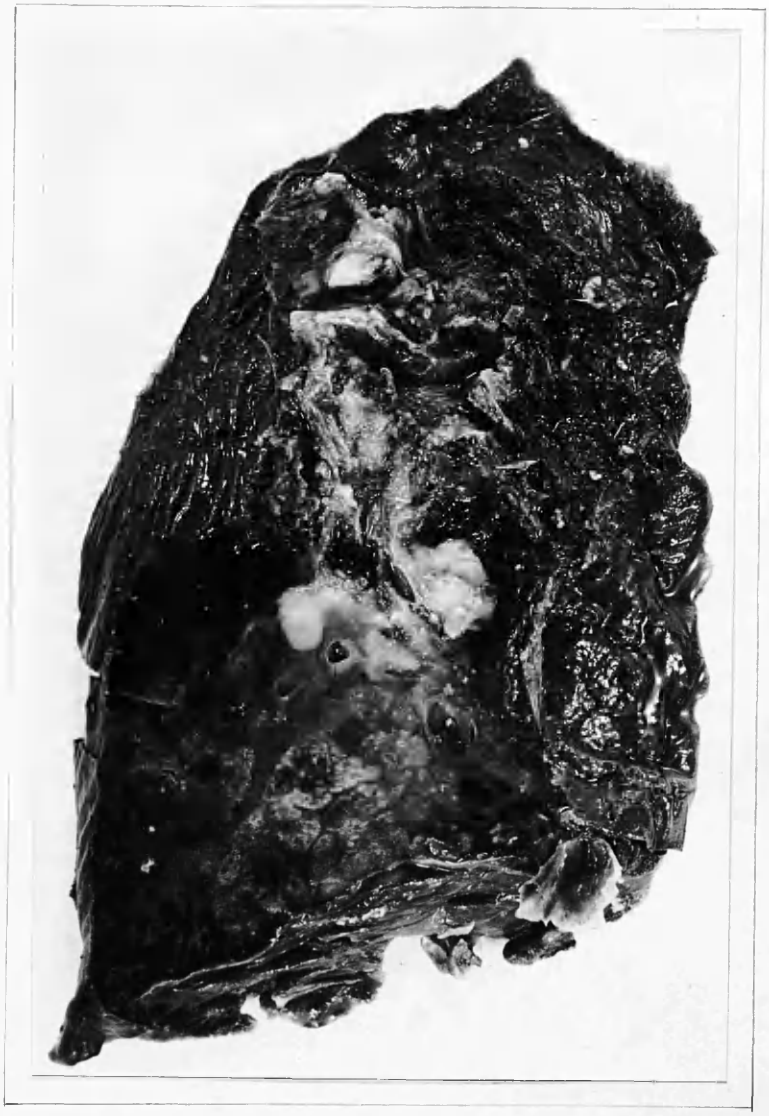


Fig. No. 252. The tumour in the apex of the left lower lobe is seen as a white area to the right of the lower part of the opened bronchial tree. The polypoidal intraluminal tumour projection can be seen to have reached the main bronchus (c.f. bronchogram). The opened upper lobe bronchus runs horizontally to the right; its segmental divisions are opened. The distal area of lung is the seat of pneumonia, bronchiectasis and abscess formation.

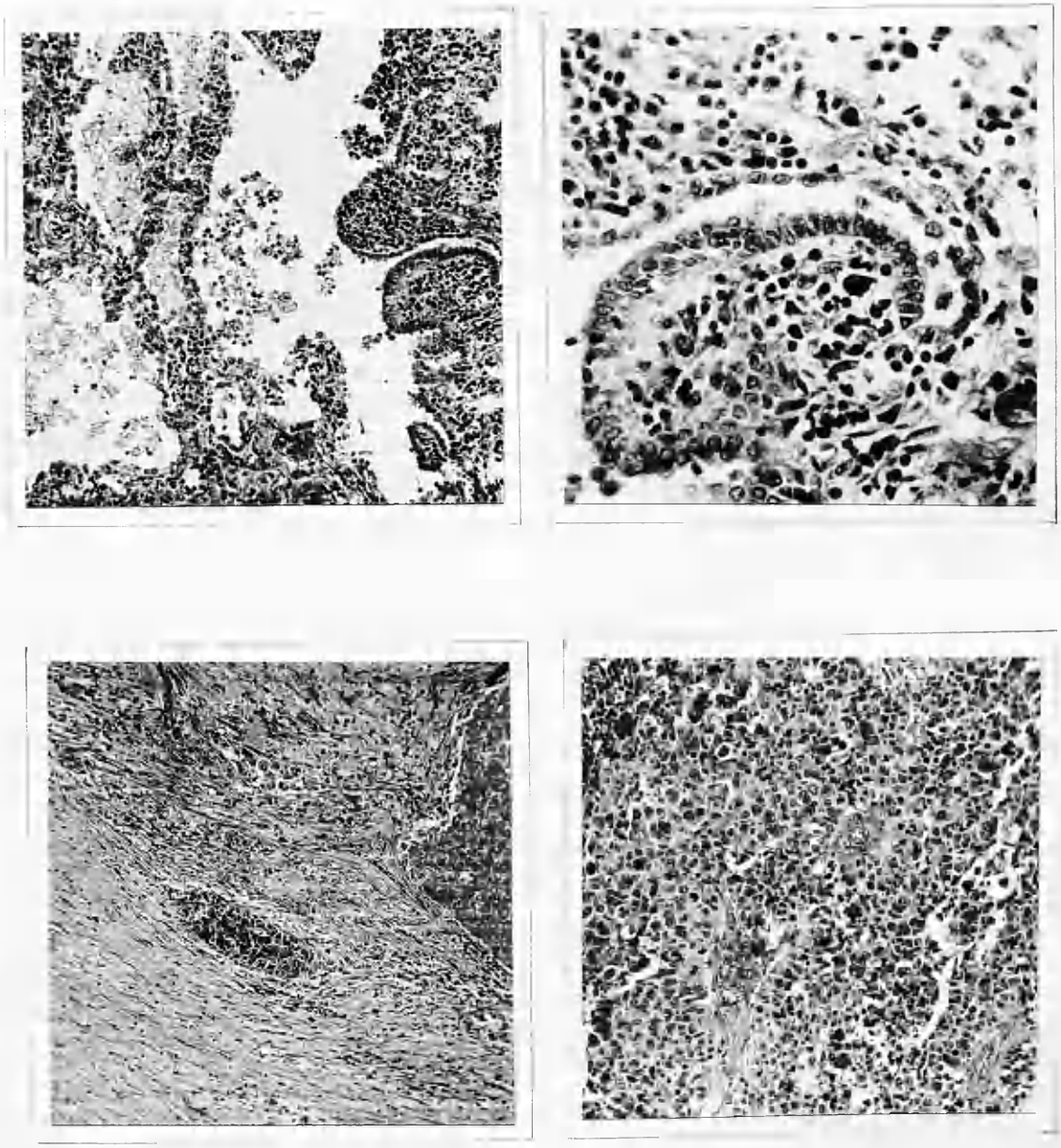


Fig. No.253. A poorly differentiated squamous epithelioma of alveolar type. The lung tissue shows abscess formation.

Case No. 74.

G.G. (46), Occupation - Accountant.

Admitted 24.5.51,

Dismissed 2.7.51.

Diagnosis Bronchial carcinoma.

History. He was well until eighteen months prior to admission, when he began to lose energy and to complain of lassitude. He was also easily tired. He had a slight morning cough but did not worry about it. He had noticed that he had lost some weight. His cough had not been troublesome and the sputum was white but never blood stained. Six months prior to admission he had complained of a pain over the left pectoral region which disappeared in six to eight weeks. He had no difficulty in swallowing. In eighteen months he had lost one and a half stones in weight, but he was beginning to put on weight. He was only breathless on climbing hills.

Examination. He was in fairly good condition, with slight loss of weight. There was no cyanosis and no clubbing of his fingers.

Respiratory system. The chest moved well and equally. The percussion note was dull over the left upper zone where the respiratory murmur was harsh vesicular.

No adventitiae were heard. Other examinations were normal.

23.5.51. Bronchoscopy, Dr. Semple. "Trachea, carina and stem bronchi normal. Tumour tissue was seen in the left upper lobe bronchus proper, not infiltrating stem bronchus. Biopsy tried but probably normal tissue".

24.5.51. X-ray Report, Dr. Munro. "Collapse of left upper lobe".

8.6.51. Operation - Mr. Fraser. Dr. Pinkerton - Pentothal, Cyclopropane, Tubarin.

Patient was placed in face-down, head-down position and the chest was opened by removing the 6th and 7th ribs, preserving the intervening intercostal bundle. The lung was adherent over most of its apex and this area was freed by stripping the pleura and the lung off the chest wall in the extra-pleural plane. Some glands were felt reasonably distally in the stem bronchus and it seemed that pneumonectomy was feasible. First the bronchus was sutured and cut, then the pulmonary artery was trebly ligated, transfixed and divided. The pulmonary veins were dealt with in a similar way within the pericardium. It was now found that there were two or three enlarged hard glands on the arch of the aorta. One of these was removed and

sent for examination. The remainder were densely adherent to the aorta and it was felt unwise to attempt to remove them. These glands felt as if they were invaded by malignant tissue but it was just possible that they might have been inflammatory. The stem of the bronchus was stitched with mattress sutures which were applied in its long axis closing the bronchus flush with the carina. The intercostal bundle was then stitched to the stump of the bronchus which was partly covered by a flap of pleura. The chest was then closed in the usual way.

Pathological Report, Royal College of Physicians, Edinburgh, Dr. Dawson. "1. Sub-carinal region lymph node - No evidence of invasion by tumour.

2. Sub-aortic lymph node - Extensive replacement of lymphoid tissue by epidermoid carcinoma, large-celled, very active, with numerous mitoses and a patchy differentiation to keratin formation.

3. Lung - Extensive abscess formation but no evidence of tumour. There is much fibrosis, foam cell formation and lung consolidation associated with pus formation noted naked eye. The great cellularity may be in part due to tumour tissue destroyed by the abscess and now not distinguishable as such".

Pathological Report, Mr. K. Fraser. "There is a carcinoma of the bronchus to the upper lobe. The tumour projects into the lumen of the bronchus and reaches in a proximal direction to within 1 cm. of the stem bronchus. The bronchus to the anterior segment is unobstructed. Distal to the tumour the apical and posterior segments of the lobe show well marked bronchiectatic changes; while the lingula shows atelectatic and pneumonic changes.

The histological picture is one of fairly well differentiated squamous epithelioma".

2.7.51. The patient was discharged home, having made a satisfactory recovery. He was sent to Dr. Scott Park where he had a course of X-ray therapy.

31.10.51. The patient was seen by Mr. Fraser as an outpatient when a secondary deposit in the fourth metacarpal of the left hand was confirmed, as had been suggested by Dr. Scott Park. A further course of therapy for this area was arranged.

15.6.52. He died.

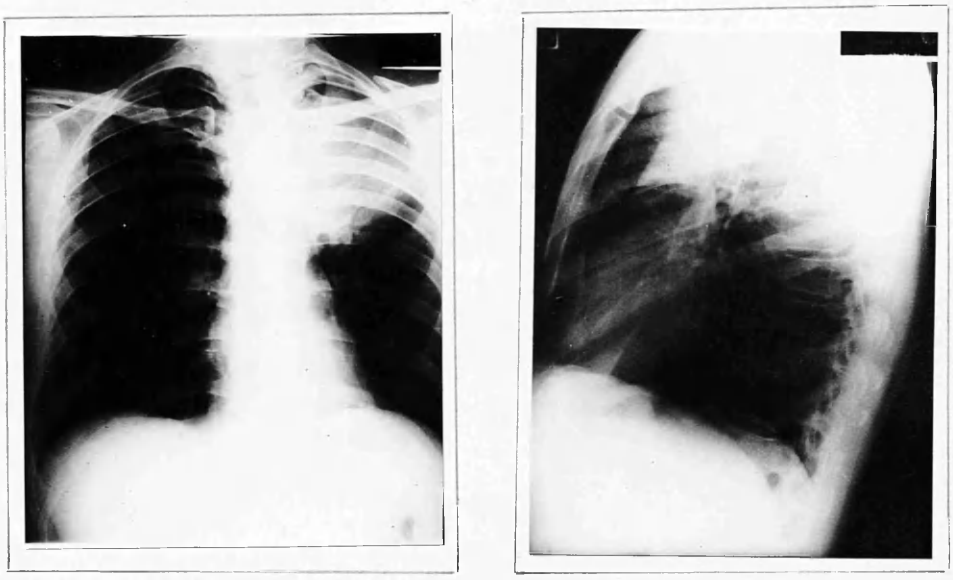


Fig. No. 254. On the postero-anterior X-ray film the upper lobe appears to be completely collapsed and consolidated, but on the lateral X-ray film the anterior segment is seen to be still aerated.

Fig. No. 255. The twin openings of the upper and lower lobe bronchi can be seen. The upper lobe orifice is to the right and in its superior aspect the tumour can be seen to "peep" out of its lumen.

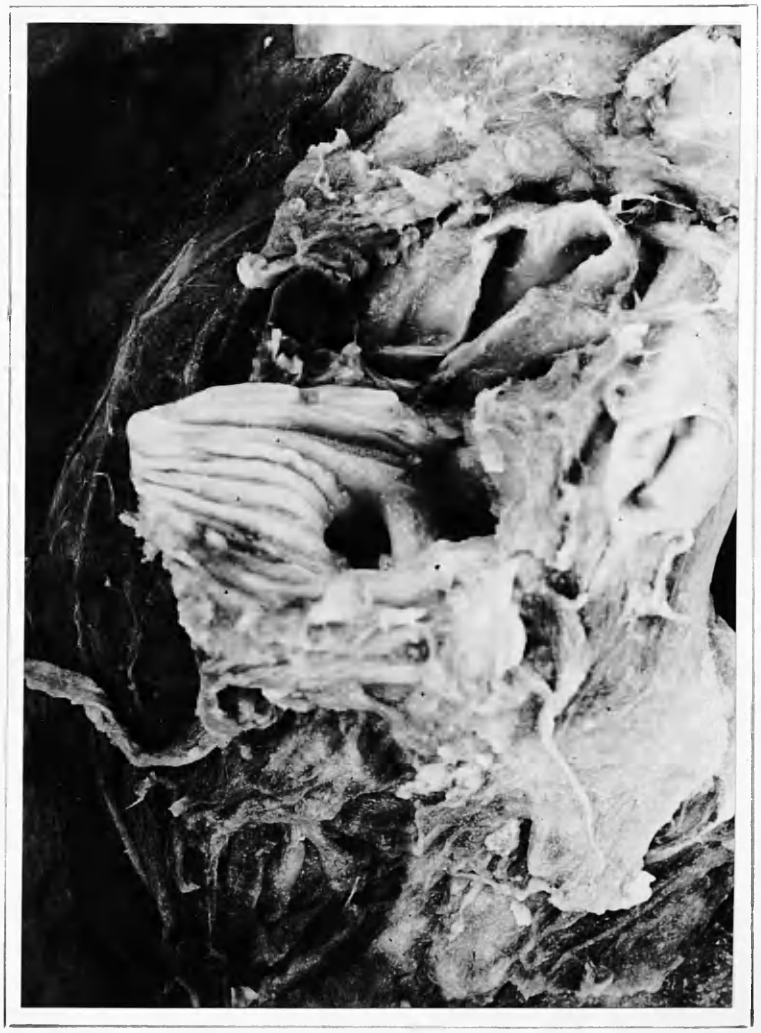


Fig. No.256. An enlarged picture of Fig. No.255 showing the tumour polyp projecting into the upper lobe bronchus.

Fig. No. 257. A deeper "cut" from the same specimen as Fig. No. 255.

Fig. No. 258. The appearance on the reverse aspect of the specimen to show the bronchiectatic and pneumonic changes.

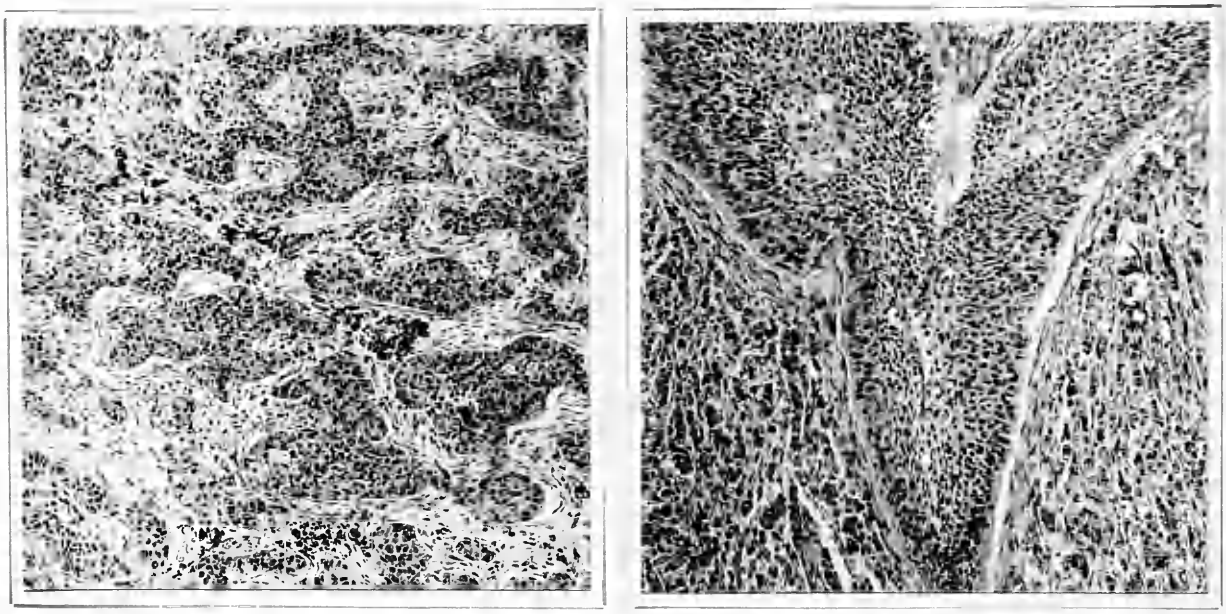
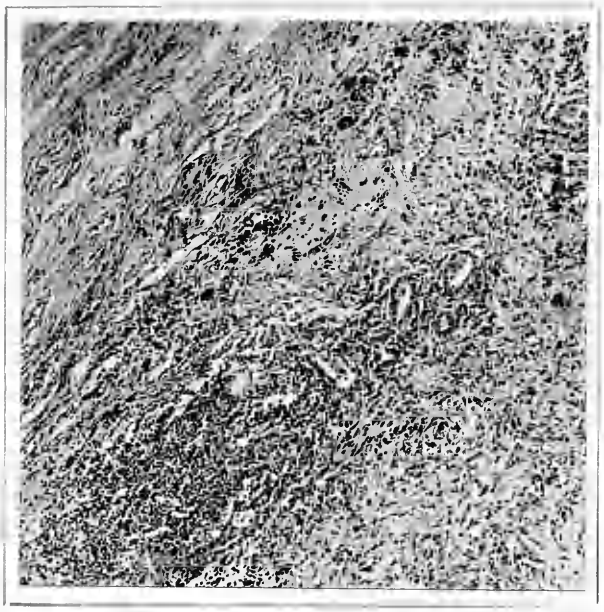
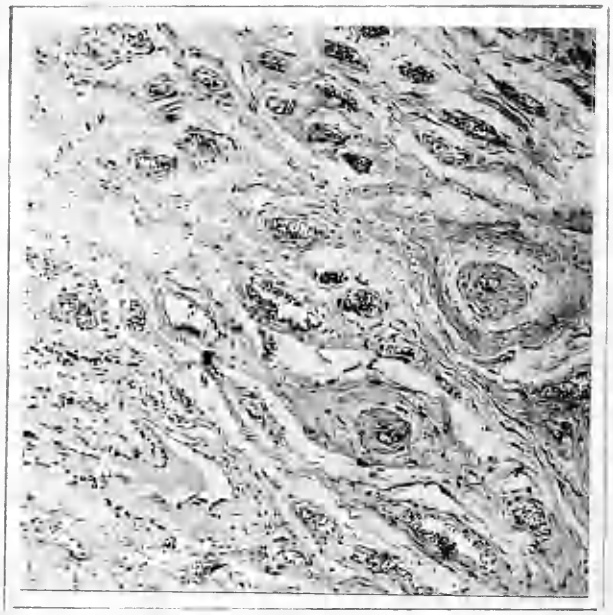


Fig. No.259. Fairly well differentiated squamous epithelioma.





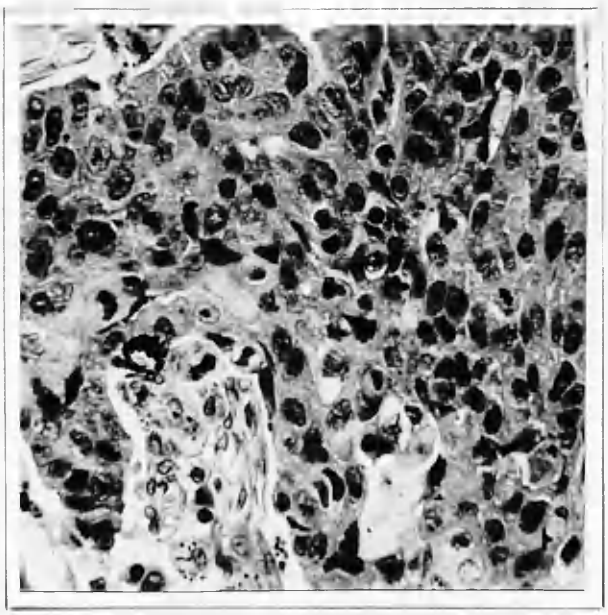


Fig. No. 260. The photomicrographs above are of the lung parenchyma showing areas of pneumonia and abscess formation. The lower photomicrograph shows a further area of tumour tissue containing a considerable number of mitotic figures.

Case No. 75.

V.R. (37). Occupation - Painter.

Admitted 10.3.48,

Dismissed 1.5.48.

Diagnosis Bronchial Carcinoma.

History. In early November 1947 he began to feel unwell and to have a pain high up in the left chest. His doctor diagnosed pleurisy. He was x-rayed five weeks later at his work. He had had no cough at this time but he developed a cough in the middle of December accompanied by spit. He was feeling tired and had lost 20 pounds in weight. He was admitted to Irvine Central Hospital on 31.1.48 and was treated with penicillin and sulphathiazole. This gave him some improvement and he had a cough now but no sputum. He had put on some weight. He had found himself breathless and wheezy for a month prior to admission. He had a haemoptysis one year prior to admission.

Examination. He was a fairly well built, healthy looking man, very wheezy and breathless. There was no cyanosis or oedema. There was early clubbing of his fingers. There were no enlarged glands.

Respiratory system. There was some fullness of the upper half of the left thorax which did not have the

same amount of movement as the right. The percussion note was markedly impaired over the upper third of the left lung. The vocal fremitus was diminished as was the vocal resonance over the same area. The respiratory murmur was vesicular with marked wheeziness and prolonged expiration. At the left upper third there were very loud and coarse rhonchi.

Cardio-vascular system showed no abnormality.

22.3.48. X-ray Report, Dr. McKail. "Homogeneous opacity with some atelectasis is present at the upper lobe of the left lung. A rounded mass 4 x 2.5 cm. is seen in the upper part of the left hilum. The left lobe of the diaphragm is slightly raised but shows normal movement.

The appearances are those of a bronchial carcinoma of the hilar type".

24.3.48. Bronchoscopy, "Trachea, carina and right stem bronchus normal. One and a quarter inches down the left stem bronchus on the medial wall there was seen a papillomatous projection, which was removed for biopsy. Just below this, at the level of the left upper lobe orifice, the stem bronchus was almost completely constricted by submucous neoplastic involvement, only a bubble of air being seen".

Histological Report from the Royal College of Physicians showed that there was no evidence of malignancy in the tissue removed.

30.3.48. Operation - Mr. Dick, Mr. Fraser.

Dr. Shaw -
Pentothal,
Cyclopropane.

The chest was opened with the usual postero-lateral incision and a rib was resected. The lung was mobilised without much difficulty. Dissection was first directed towards displaying the bronchus, as the artery and vein were rather difficult to clear. In clearing the bronchus, the pulmonary artery was accidentally injured but was brought under control with a pressure forceps. Individual ligation of the pulmonary artery and the superior vein was found to be impossible and they were ultimately tied together. The bronchus at this stage was then clamped and divided. When the bronchus was cut across, it retracted out of sight into the mediastinum but was brought back into view and was sutured. On release, it returned out of sight into the mediastinum and no further attempt was made to suture it. The wound was closed after introduction of penicillin-sulphathiazole powder.

N.B. On opening the chest it was noted that the

lower lobe was emphysematous but that the upper lobe was collapsed; this was presumably due to the mechanism of the tumour.

1.4.48. His condition was satisfactory and his tube was working.

5.4.48. He was feeling a certain amount of pain in his wound but he was allowed up.

10.4.48. Pathological Report, Mr. K. Fraser. "The main bronchus has an ulcerated area of tumour which projects into it and almost occludes its lumen. The tumour appears to have originated below the origin of the upper lobe bronchus but this bronchus is now occluded almost completely by tumour. At one side of the main bronchus there is an enlarged gland which is seen on the cut section of the lung on its reverse side. This gland shows a pale necrotic centre which might be due to tubercle or to tumour. The lobe of the lung is markedly bronchiectatic distal to the tumour.

The histological picture shows a well differentiated squamous epithelioma; there is little pleomorphism and few mitotic figures are seen".

20.4.48. His progress was so satisfactory that he was allowed home.

Five years after operation this patient was still alive and well.

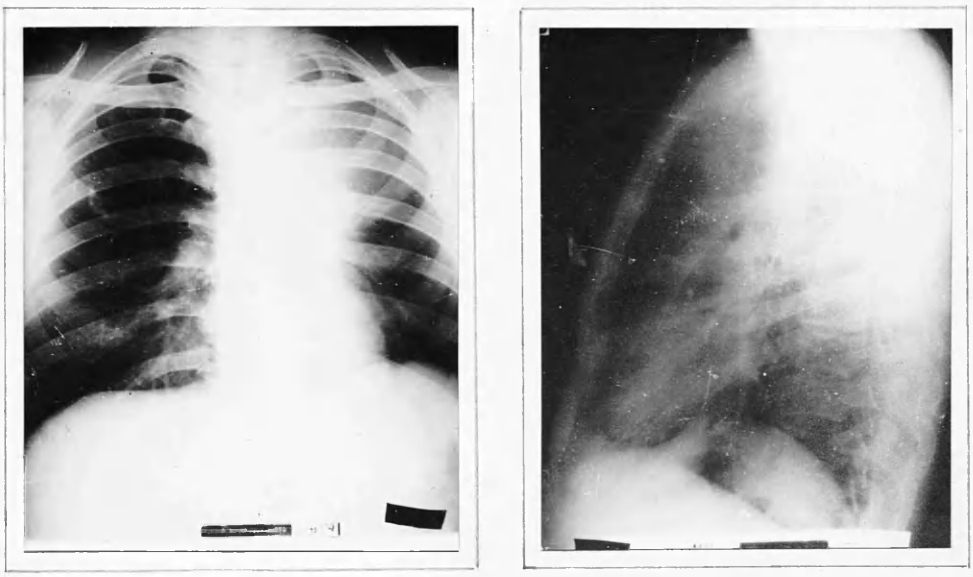


Fig. No. 261. There is complete opacity of the left upper lobe due to atelectasis. The mediastinum and the heart are retracted to the left and the left diaphragm is elevated (it moved normally with respiration).

Fig. No. 262. The specimen is turned so that the upper lobe is below. The stem and the upper lobe bronchi have been laid open by removing a segment of bronchial wall. A polyp of tumour is seen peeping out of the bronchus. The upper lobe bronchus has been opened widely. The tumour has invaded the bronchus over a lengthy area and the greatly thickened bronchial wall is clearly seen; the lumen is practically occluded.

Fig. No.263. A slightly different photograph of Fig. No.262 in which the invaded bronchial wall shows up as white tumour tissue.

Fig. No. 264. The specimen has been reversed and the upper lobe (lying inferiorly) has been cut across. It shows gross bronchiectasis. The very white circular area at the hilum between the two lobes is an area of invasion in the centre of lymph gland.

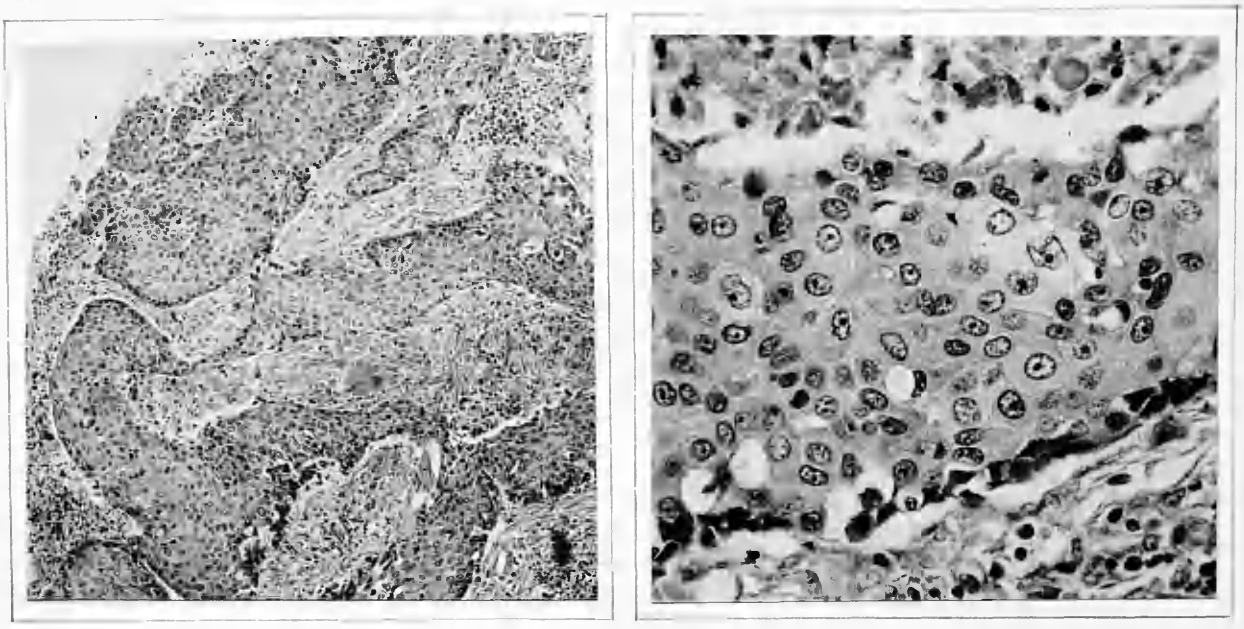


Fig. No. 265. The tumour is a well differentiated squamous epithelioma. There is very little pleomorphism and no mitotic figures are seen.

Case No. 76.

P.R. (38) Occupation - Fisherman.

Admitted 12.10.50,

Dismissed 28.11.50.

Diagnosis Bronchial carcinoma.

History. Six months prior to admission he was well but noticed that he was losing weight. Two months later he developed a dry irritating cough, which troubled him mainly at night. Three months prior to admission he developed an influenzal illness and was in bed for a week; subsequently he felt fairly well but was weaker when he exerted himself. He now found that he was dyspnoeic on exertion and he developed a pleuritic type of pain in his right lower chest. He was x-rayed at this time and an effusion was detected with collapse of the lower lobe of his lung. The effusion in his chest was aspirated shortly before admission and it was found to be blood stained.

Previous health. He had rheumatism in his shoulders when he was 21 but this had disappeared.

Examination. He was a rather lean man of pale complexion and was not cyanosed. Small lymph glands were palpable in both axillae; his fingers were not clubbed.

Respiratory system. He had a thin chest with slight dorsal kyphosis. Movement was rather shallow and was relatively limited in the right lower chest. On percussion there was dullness over the right lower zone posteriorly and in the axilla. No respiratory murmur was heard in this area. The vocal resonance was unaltered. A few scattered crepitations were heard over the left lung.

Alimentary system, cardio-vascular system and central nervous system showed no gross abnormality, although there was a systolic thrill at the apex of his heart and a presystolic murmur was heard.

13.10.50. X-ray Report, Dr. Donald. "There is some elevation of the right dome of the diaphragm and appearances in the lateral view suggest an interlobar effusion, the exact cause of which is indeterminate at present".

18.10.50. It was felt that his presystolic murmur indicated a definite mitral stenosis.

Bronchoscopy, Dr. Semple. "Trachea and carina normal. There is a red polypoid growth obstructing the right lower lobe bronchus. Biopsy taken".

25.10.50. Pathology Report, Dr. Steven. "Microscopical appearances are those of a very active

epidermoid carcinoma of the bronchus. The tumour forms solid masses of irregular size and contour with well marked pallisading of their peripheral cell layers. The cells are highly pleomorphic with hyperchromatic and often grossly aberrant nuclei showing numerous mitoses. At some points the pattern is frankly squamous with intercellular "prickles" but no epithelial pearl formation is evident. A few small areas are to all intents and purposes of oat-cell pattern. There is a moderate degree of secondary infection. The prognosis in this case cannot be regarded as much better than in a purely oat-cell tumour.

Very active epidermoid carcinoma".

27.10.50. Operation - Mr. Dick, Mr. Fraser.

Dr. Pinkerton -
Pentothal,
Cyclopropane,
Gas & Oxygen.

The right hemithorax was opened through the usual postero-lateral incision. Ribs 6 and 7 were resected with conservation of the intervening intercostal bundle. There was no free fluid but the lower lobe was firmly adherent to the chest wall and diaphragm. The lobe itself was converted into a firm tense rounded mass

from which some muco-pus exuded while it was being stripped from the parietes. These adhesions appeared to be purely inflammatory.

The pulmonary artery was first dissected free and after proximal ligation with a catgut suture, was divided between two silk transfixing sutures. The bronchus was now displayed and clamped. The superior and then the inferior pulmonary veins were in turn freed, ligated and divided in a similar manner to the artery. The bronchus was cut across and the lung was removed.

It was now possible to dissect out a number of large soft glands. Two large glands lying at the carina were removed for histological examination together with some smaller soft glands at the root of the inferior pulmonary ligament. Not all these latter glands were removed.

The bronchus was closed with several proximal mattress silk sutures and then a more distal continuous suture. The anterior end of the intercostal bundle was stitched over the bronchial stump and the mediastinal pleura was closed fairly completely above and below the stump. Penicillin-sulphamethazine powder was applied and after bringing out a de pezzer

catheter, the chest was closed after the instillation of 250,000 units of penicillin and crushing of the phrenic nerve.

10.11.50. Pathological Report, Mr. K. Fraser. "There is a tumour 2 x 3 cm. in diameter invading the stem bronchus to the lower lobe. This tumour reaches up to, but does not block, the bronchus to the middle lobe. The carina between the two bronchi is broadened. As one proceeds down the lower lobe stem bronchus, it becomes progressively occluded by tumour tissue. There appears to be an invaded gland at the side of the middle lobe bronchus and also one stem bronchus gland opposite to the origin of the upper lobe bronchus. The lower lobe distal to the tumour is solid, and shows changes typical of pneumonia, bronchiectasis and abscess formation. Diaphragmatic pleura is thickened to as much as 0.5 of a centimetre in places by chronic inflammatory reaction.

This is a squamous epithelioma which is moderately well differentiated. Quite a number of mitotic figures are present. There is well marked pleomorphism. None of the lymph glands examined show invasion".

28.11.50. He made a good recovery and was discharged home.

1.2.51. He died at home with evidence of secondaries.

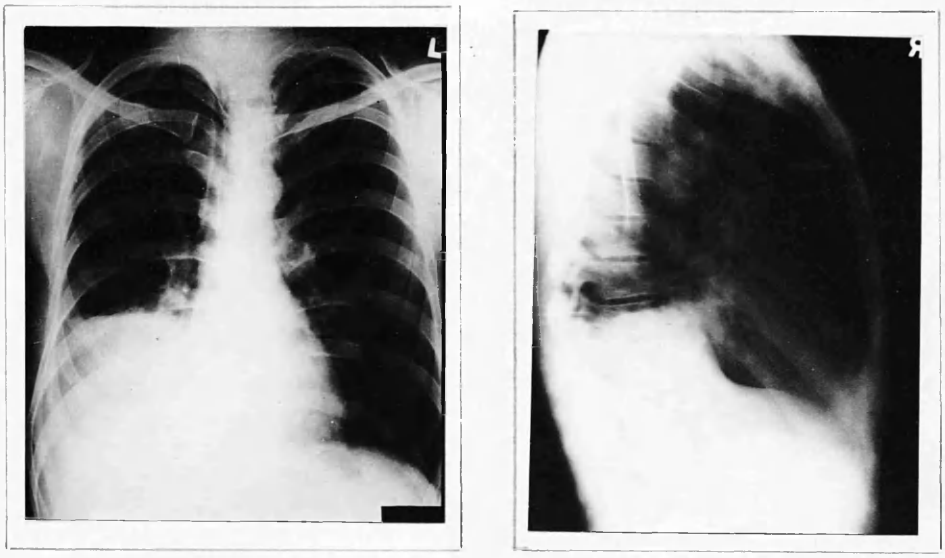
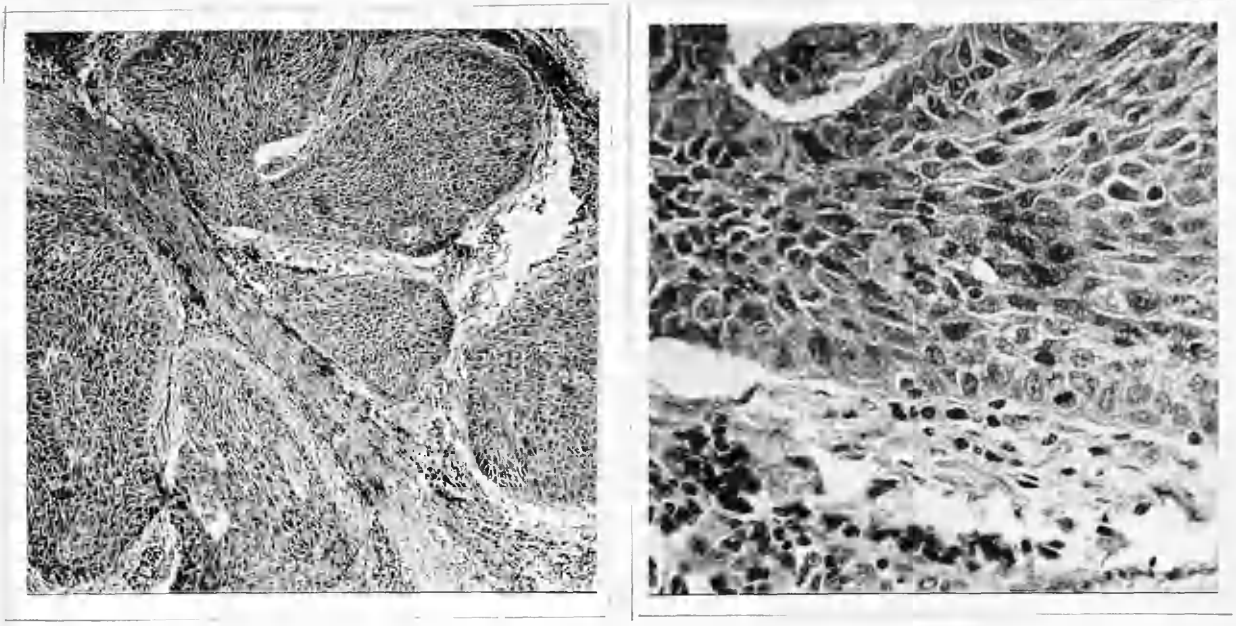


Fig. No. 266. The right lower lobe shows atelectatic and pneumonic consolidation due to a tumour in the lower lobe bronchus. The upper and middle lobes have hypertrophied and "fanned" downwards to "fill in" the collapsed area. The right diaphragm is elevated due to the collapse.

Fig. No. 267. The stem bronchus has been opened widely. The upper lobe orifice is seen at the superior extremity of the bronchus. The tumour is visible surrounding the lower lobe bronchus. The middle lobe bronchus can be seen opening off to the left; the carina between it and the lower lobe is broadened but the lumen of the middle lobe bronchus is not compressed.



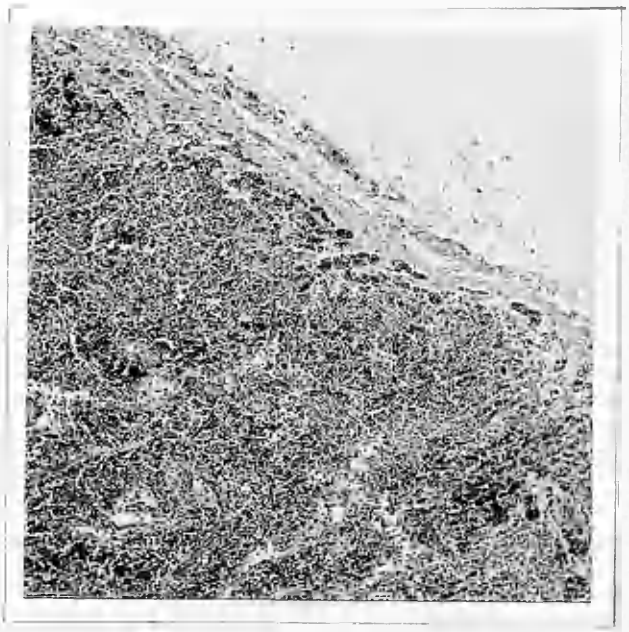


Fig. No. 268. The top left photomicrograph shows a fairly well differentiated squamous epithelioma; there is, however, marked pleomorphism and a considerable number of mitotic figures. The top right picture shows necrotic tumour tissue, while the lower photomicrograph shows inflammatory changes in the distal lung tissue.

Case No. 77.

J.W. (53). Occupation - Miner.

Admitted 28.11.49,

Dismissed 10. 1.50.

Diagnosis Bronchial carcinoma.

History. In July 1947 he had a febrile illness with headache and sickness. A few days after the onset of his symptoms he was admitted to Edinburgh Royal Infirmary where he was detained for five weeks and later was sent for three weeks to a Convalescent Home. He was diagnosed as having pneumonia but he had had no symptoms referable to his chest and no breathlessness or cough. On discharge from hospital he felt well, apart from a degree of breathlessness which had persisted in the intervening two years. Until three weeks prior to admission he was able to walk from his home to his work without respiratory embarrassment, - a distance of two miles. He had had no cough, sputum or haemoptysis. Three months prior to admission he complained to his doctor of discomfort in the right axilla, unaffected by exercise or deep breathing. There had been no recent loss of weight.

Examination. He was a well nourished man of good complexion and average physique. There was no

clubbing of the fingers, no distension of veins and no palpably enlarged glands.

Respiratory system. There was no impairment to percussion. Respiratory murmur was vesicular. Vocal resonance was a little increased over the right upper lobe posteriorly, especially towards the mid-line. No adventitiae were heard. Other systems showed no abnormality.

14.10.49. X-ray Report, Dr. McKail. "There is a rounded opacity of homogenous density in the axillary subapical segment of the upper lobe of the right lung close to the chest wall. It measures 6.5 x 6 cm. and its margins are slightly irregular. The mass has displaced the oblique fissure downwards but there is no obvious bony involvement.

The appearances are characteristic of a tumour, most probably a bronchial carcinoma".

30.11.49. Bronchoscopy, Dr. Semple. "Trachea and carina normal. Rather red. Left stem bronchus normal and right stem normal, apart from the presence of coal particles. Right upper lobe bronchus viewed and seen to be normal. Just below the right upper lobe orifice and lateral wall of the stem is seen a small hole about 2 mm. in diameter, rather like a

subsidiary bronchus.

Conclusion - Normal tracheo-bronchial tree".

3.12.49. Diagnostic pneumothorax showed the lung to be free.

16.12.49. Operation - Mr. Fraser, Mr. McCluskie.
Dr. Pinkerton -
Pentothal,
Cyclopropane.

The right chest was opened and the 4th and 5th ribs were resected, conserving the intervening intercostal bundle. The pleura was found to be free apart from some adhesions between the anterior part of the apex of the upper lobe and the chest wall. These adhesions were easily broken. The tumour was found to lie posteriorly in the inferior part of the upper lobe; it formed a discrete solid mass. There were no mediastinal glands involved. The mediastinal pleura was incised and the bronchus was easily secured and clamped. The pulmonary artery was next isolated and divided between double ligatures and also transfixed with silk sutures. The superior and inferior pulmonary veins were then secured and similarly divided. The bronchus was cut across about a third of an inch from the carina and the lung removed. The bronchus was closed using a double row of sutures: interrupted

mattress sutures proximally and interrupted single sutures distally. The anterior end of intercostal bundle was then sutured to the bronchial stump. Penicillin-sulphathiazole powder was applied and the phrenic nerve was crushed. A drainage tube was inserted and the wound was closed with penicillin.

Pathological Report, Royal College of Physicians.

"Lung. 1. Carcinoma.

2. There are large amounts of fairly irregular epithelial cells with thin strands of connective tissue between the cell masses. There is much mucus in the centre of these masses resulting in the formation of necrotic cysts lined with tumour cells.

4. The malignant cells are of moderate size, show no differentiation to prickle cells and no glandular differentiation.

A moderate number of mitotic figures.

Lymph Node, 1. This shows much carbon pigment deposition, but no evidence of malignancy".

17.12.49. His pulse was irregular and variable in quality.

19.12.49. His pulse was of fair quality and regular.

20.12.49. A de pezzer catheter was removed, as it had ceased to drain and a moderate quantity of blood