Fig. 1.—Carcinoma of lower and middle lobes right lung, showing atelectasis of lower lobe and distension due to partial obstruction in middle lobe.
CARCINOMA OF THE BRONCHUS*

BY

A. TUDOR EDWARDS

The subject of malignant disease of the lung, particularly bronchogenic carcinoma, appears to be a suitable one for such an occasion as this for many reasons. It is a condition of considerable importance owing to its increasing incidence; it clearly illustrates the advance in diagnosis and treatment in chest disease attained during the last 20 years. It affords, in all its various aspects, opportunities to all sections of this Association for study, and, lastly, it is a subject which has always been of considerable interest to me personally.

That the disease shows an absolute increase apart from the relative increase due to improving clinical diagnosis is shown by many authorities, largely as a result of autopsy findings in large groups of cases. The increasing trend is evident, even so far back as the period 1900-10, but it has become much more marked in the post-war period following the First World War. Up to 1925 the majority of the figures from large series of autopsies came from Germany, although in the years immediately following, Bonser at Leeds, Duguid at Manchester, Maxwell and Nicholson at St. Bartholomew's, and Simpson at the London Hospital all produced significant figures showing not only the increase in cases of bronchial cancer coming to autopsy but the absolute increase in comparison with cancer in other regions.

The causes of the increasing incidence are necessarily difficult to determine, but many factors have been held responsible by different observers. Influenza, with its effects on bronchial mucosa of atypical regeneration, metaplasia, and cell-nest formation, has been widely suggested as a predisposing cause. On the other hand, Iceland, where carcinoma is, or rather was, unknown, has suffered from severe epidemics of influenza. Other factors, such as smoking, exhaust gases from motor vehicles, tar particles from roads, have all been held responsible; but the whole matter is difficult of proof, and it is probable that these are factors which prepare the soil rather than sow the seed.

PATHOLOGY

The first interesting feature of the pathology has been the rapid disappearance from the literature in the late 'twenties of reports of numbers of sarcoma of the chest. That sarcomas do occur in both the lung and mediastinum is well recognized, although reports of sarcoma of the lung during the last 15 years are

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FIG. 2.—Section of left lung showing carcinoma of left upper lobe.

relatively rare. Personally, I have operated upon three such cases—two in the lung showing ossification, and one arising in the periphery of the apex. The recorded incidence of sarcoma in the mediastinum has likewise much diminished, largely as a result of the pioneer work of Barnard published in 1926, and later supported by Duguid (1927) and Shennan (1928). Barnard pointed out that many of the so-called sarcomas proved to be carcinomas as a result of histological examination of the minute structure, arrangement, and staining reaction of the cells, upon which the differentiation and grouping of these new growths depend.
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Fig. 3.—Endothelioma of lower lobe, removed by dissection lobectomy in 1928; still surviving.

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Many of these cases showed the manifestations of primary mediastinal tumours, which we now know are secondary to bronchogenic carcinomas, often of the submucous infiltrating type without pulmonary symptoms or signs. The diagnosis in life between these and the true sarcomas in mediastinal structures, such as glands, thymic tissues, etc., is often dependent upon biopsy of enlarged glands in neck or axillae.
Case 1.—(1) Radiograph of woman, aged 38, with hemoptysis; slight thickening of upper part of left hilum and some thickening of bronchial outlines in left upper lobe.

Case 1.—(2) Radiograph showing definite atelectasis in same patient 4 months later, due to obstruction of left upper lobe bronchus by carcinoma.
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Another point of interest is the pleomorphic nature of carcinomas of the lung. In many cases the growths show a different structure, not only in different parts of the tumour but often in the same microscopic field. Fried has put forward the view that: (1) all primary carcinomas of the lung are bronchogenic; (2) there is evidence that when the disease is found in the lungs it results from a pathologic (excessive) regeneration following chronic inflammation of the bronchial tree; (3) of the three varieties of cells lining the bronchial mucosa—that is, the ciliated columnar epithelium, the goblet cells, and the basal cells—only the last-named take part in the process of regeneration of the bronchial mucous membrane. It is therefore assumed that these cells likewise serve as the sole matrix for primary bronchogenic tumours; and (4) similarly, primary squamous-celled epitheliomas and basal-celled epitheliomas do not result from metaplasia of the pre-existing ciliated columnar epithelium, but originate through protoplasia of the undifferentiated basal cell of the bronchial mucous membrane.

The bronchogenic carcinomas have been differentiated up to a certain point as adenocarcinomas, medullary carcinomas, oat-celled carcinomas of Barnard, and the epitheliomas or squamous carcinomas. Fried is of the opinion that of the adenocarcinomas, the cuboidal, and the high columnar-celled types, the former is more apt to invade blood vessels early, whereas the latter has a more pronounced tendency to give rise to implantation metastases, although both have a high degree of malignancy.

SECONDARY DEPOSITS

Apart from the type of growth, much speculation has arisen over the factors responsible for the relative incidence of metastasis. Tuttle and Womack (1934) advanced the view that the more peripheral or bronchiolar groups metastasize early, and in an analysis of 44 cases they showed that the duration of life of patients with carcinoma arising in the major bronchi (23 cases) was 26.3 months, whereas in those with peripheral growths (21 cases) it was only 7.3 months. This was shown by another test—namely, that of visualization by bronchoscopy, in which those so visualized survived 33.9 months, whereas in those not so visualized death occurred in 13.7 months.

Experimentally, they showed that particulate matter injected into the submucous tissue of the main bronchi was much slower in its appearance in lymphatic glands than that injected into the periphery of the lung. They account for the increased incidence of secondary growth with peripheral tumours as due to increased mobility, greater vascularity, vascular channels with thin walls, and the absence of the cartilaginous barrier of the larger bronchi. Other writers consider that the peripheral growths offer the greatest opportunity for surgical excision, although much of this was published before modern technique made successful pneumonectomy possible. It would appear to me that the two factors, (1) situation of growth and (2) histological features, should both be taken in conjunction when offering a prognosis. Many of the peripheral growths are non-keratizing
Case 2.—(1) Radiograph showing partial atelectasis and multiple cavities in upper lobe secondary to carcinoma of upper left bronchus.

Case 1.—(2) Same patient one month after pneumonectomy and following aspiration and air replacement.
epitheliomas, and in such cases the outlook is better even with dissection lobectomy, but when the peripheral growth is of the undifferentiated type, although its surgical removal may be early and apparently complete, disappointment often occurs from metastases to brain and elsewhere, which may lead to the death of the patient even as late as three years after operation.

**Diagnosis**

Early diagnosis still offers considerable difficulties, not so much once the patient has reached the practitioner (as the profession as a whole is much more conscious of the possibilities of cancer of the lung than formerly, and is more inclined to submit the patient to radiological investigation), but, owing to the fact that many cases of the disease are relatively symptomless, or with so insignificant or unassessable a symptom as lassitude, until late in the disease. As we all know, in many cases the secondary deposits give the first symptoms, such as those of cerebral tumour, loss of voice due to recurrent laryngeal palsy, urgent dyspnoea due to a large pleural effusion, or even direct extension to the heart, suggesting coronary occlusion. At this stage operative treatment is out of the question and radiotherapy of questionable value.

The patient whose first symptom is a brisk haemoptysis is indeed fortunate, as it should lead to full investigation. More often the history is one of infection due to obstruction of a large or small bronchus, although a history of streaking of sputum with blood can often be elicited by questioning. This group has a persistent or intermittent pyrexia.

Cough is an almost invariable symptom, but it is often disguised by a long history of bronchitis, or is considered by the patient as due to smoking.

Pain, usually due to extension of the disease from the lung to the parietes. cyanosis, and loss of weight are all late symptoms. Definite dyspnoea is likewise a late symptom, not due to the amount of lung put out of action by the disease, but strongly suggestive of fixation of the mediastinum. If patients with this symptom who are not suffering from an associated emphysema are closely questioned it will generally be found that they complain of a sense of inability to fill the lungs completely, which depends upon movement of the lung root vertically.

Examination by ordinary clinical methods may be entirely negative. Other cases give rise to the physical signs of lobar or localized atelectasis.

The examination of the supraclavicular and axillary regions for secondary glands should not be omitted; and abdominal examination will include palpation of the liver for enlargement or irregularities of surface.

Clubbing of fingers and pulmonary osteo-arthropathy is common in carcinoma of the lung, and occasionally is of long standing even before the pulmonary condition is diagnosed. The most advanced case I have personally seen was referred to me from the National Hospital, Queen Square, where the patient had been sent with a diagnosis of acromegaly, and was found to be suffering from an apical
CASE 2.—(2) After artificial pneumothorax, cavities now clearly shown.

CASE 2.—(3) Tomograph cut through main bronchi showing partial obstruction of left upper bronchus.
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carcinoma involving the upper two ribs and beginning to involve the brachial plexus.

No satisfactory explanation has been advanced for these changes, but Fried has put forward evidence to suggest that osteo-arthritis found in neoplastic diseases of the lung is in all probability caused not by toxins nor by circulatory disturbances but by an endocrine imbalance akin to acromegaly.

Radiological examination should never be omitted, but it must be recognized that a carcinoma can occur in one of the larger bronchi without any radiological change in the lung, provided there is insufficient obstruction to interfere with the free inflow and outflow of air to and from the lung beyond. In the majority of cases, however, a shadow will be evident on the film. This will outline the lobe when its main bronchus is obstructed, and, of course, the shadow is due to the atelectatic lobe, and may be caused by quite a small growth. In others, particularly the peripheral or bronchiolar tumours, the shadow, which may be well circumscribed, usually corresponds to the outline of the growth itself. Such a growth, and particularly the squamous-celled variety, tends to break down in the centre, and not uncommonly is thought to be a chronic abscess, owing to the appearance of a fluid level in the radiograph. In these cases the wall is of considerably greater thickness than is common in chronic abscesses, and can be well demonstrated by the tomograph. Only one condition, in my experience, gives the same thick, homogeneous appearance of the wall radiologically as a breaking-down bronchiolar carcinoma, and that is amoebic pulmonary abscess, which is relatively rare.

Screen examination should not be neglected, particularly in relation to the diaphragm. A recent hemiparesis of the diaphragm may not indicate inoperability of a carcinoma, as it can be completely removed by including a portion of the pericardium, which has been recently invaded by growth with the phrenic nerve, in the excision.

Sputum examination for malignant cells will occasionally clinch the diagnosis. Rarely portions of the growth are coughed up, and the diagnosis is in no doubt, but routine examination of the sputum by Dudgeon's "wet film" method should be more commonly employed. It requires considerable experience to enable accurate recognition of malignant cells in the sputum to be attained, but it can be of prime importance in those cases of growth beyond the range of the bronchoscope.

Bronchoscopy should never be omitted. The movements of the vocal cords are visualized, and either a growth projecting into the lumen of the main lobar bronchi or early secondary lobar bronchi may be seen, and a specimen removed for biopsy or submucous infiltration and narrowing of the bronchi observed. Occasionally, a bulging causing deformity without involvement of the bronchial mucosa is the only visible lesion.

Broadening of the carina caused by enlargement of the subcarinal glands is usually taken to be a sign of inoperability, but it is not an infallible one, as
Case 2.—(4) Pleural cavity now slowly filling with fluid on ceasing to aspirate and air replace, 9 weeks after operation.

Case 2.—(5) Five months after pneumonectomy, showing displacement of trachea to the affected side; diaphragm raised. Heart displaced to left and small air bubble in apex of pleura.
inflamed glands may be responsible, and occasionally an appearance of flattening is given by the pulling over of a collapsed lung. Fixation and immobility of the main bronchi is almost invariably evidence of inoperability.

The naked-eye appearances of a tumour are of some significance, particularly in helping to determine between the so-called adenoma and the carcinoma proper. The former, although sometimes very vascular, is usually smooth in surface and more polypoid in appearance, although the base is often broad, and ulceration of the surface uncommon.

Thoracoscopy is of little value in any case in which operability is likely, as the removal of a portion by biopsy forceps will contaminate the pleural cavity with malignant cells and possibly infective material from the lung. Similarly, removal of a piece of tumour for microscopic examination by aspiration through a large-bore needle should never be carried out except in the diagnosis of a tumour, which, should it prove to be a carcinoma, would obviously be inoperable.

For recurrent effusion in the pleura, blood-stained or serous, thoracoscopy after air replacement has a definite place in diagnosis; in other cases of tumour its value is limited, unless the tumour is on the surface of the lung or arising from the chest-wall. In one case of angioma of the lung involving the visceral pleura a definite diagnosis could be made by this procedure before operation.

Operability

The proportion of cases operated upon to those in whom the lobe or lung can be removed must necessarily be high. Two factors must essentially be taken into account when the question arises—the general condition of the patient and the local condition. The general condition will depend upon such factors as age, condition of cardiovascular and respiratory systems, associated conditions, such as diabetes, etc. Age is dependent upon so many variables that of itself it is not of supreme importance.

In general, it may be said that older women stand operation better than men of the same age, although carcinoma is much less common in this sex. It is probable that few men over the age of 65 will stand pneumonectomy, largely as a result of defects in the cardiac and respiratory systems. Obviously, victims of arteriosclerosis or other degenerative conditions of the cardiovascular system are poor subjects for any operation, and when, as is so often the case, this is associated with pulmonary emphysema and a rigid thoracic cage, the outlook for any major thoracic procedure is extremely poor. The majority of patients submitted to operation will fall within the age group 40–60, although there should never be a hard-and-fast rule.

Emphysema is of importance when the removal of a lung is under consideration. In this lies the advantage of a preliminary artificial pneumothorax, which in two of my patients made it evident that the remaining lung tissue was insufficient to support life, and any idea of radical operation had to be abandoned.
Case 3.—(1) Man, aged 57. Bronchiolar or peripheral carcinoma.

Case 3.—(2) Three weeks later shadow is obviously increased.
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Broncho-spirometry, enabling the function of each lung to be assessed individually, entails too much intrabronchial manipulation, with its tendency to cause bronchitis and thus to delay operation or result in post-operative complications, to warrant its use in these cases.

The function of the kidneys, likewise dependent upon the cardiovascular system, requires investigation, and gross deficiency contraindicates operation.

Local conditions of operability depend largely upon the presence of secondary deposits and upon local invasion. The former should be sought in the presence of glands in the neck and axillae, and in broadening of the mediastinum as shown by bronchoscopy, radiographs or tomographs of the chest. Obviously, venous congestion or oedema of the upper part of the body, paralysis of the left vocal cord, or effusions into the pleura contraindicate the possibility of radical operation. In only one case with a history of recent pleural effusion was pneumonectomy possible, and recurrence caused the death of this patient within the year. Constant localized pain suggests involvement of a portion of the thoracic parietes, and such cases are rarely found to be operable. Enlargement of the liver should be eliminated also as a site of secondary growth.

Patients without these definite contraindications should be submitted to exploratory thoracotomy, and of these some 50 to 60 per cent will be found operable. The remainder will be found either to have invaded a part of the chest wall which is not removable, such as the vertebral column, the cardiac muscle, to present a mass of irremovable glands in the hilum, or show complete fixation of the hilum associated with the main mass.

Pre-operative measures will include an attempt at the induction of pneumothorax, which should be initially tried over the non-affected lobe—that is, over the upper lobe in carcinoma of the lower lobe bronchus, and vice versa. This method has definite advantages in that (1) it gives the surgeon an idea of the difficulties to be encountered during operation; (2) it may permit collapse of a lobe, infected beyond a partial obstruction; (3) it acts in some measure as a test of the function of the remaining lung; and (4) it diminishes the blood supply to the affected lobe and prepares for the blood shunt which takes place after pneumonectomy. Where almost complete blockage of a bronchus is associated with pyrexia due to retained secretions, an attempt should be made to empty the lobe by bronchoscopic suction and postural drainage, occasionally associated with enough removal of the intrabronchial portion of the growth by forceps to encourage drainage.

Anaemia may necessitate a blood transfusion several days before operation.

Operation

I do not propose to enlarge on the question of anaesthesia beyond expressing the view that intubation of the trachea in one or other form is essential if complete control of the patient is to be attained.
Case 4.—(1) Man, aged 61. Carcinoma of right upper lobe, rather resembling old florid tuberculosis.

Case 3.—(2) Lateral view showing outline of tumour. Patient submitted to successful operation without complication; died 3 years later from cerebral metastasis.
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The first essential after anaesthesia, or even before it is started, is to prepare the internal saphenous vein for transfusion. A very slow saline drip is started, and is followed by blood as soon as the patient begins to lose blood. In other words, an attempt should be made to replace blood as it is lost rather than to resuscitate a patient who is suffering from haemorrhage. This measure is of extreme importance, and in my opinion is the chief factor in improving the operative results of recent years, compared with those of ten years or so ago.

The incision should follow the usual postero-lateral pattern, and a long segment of the fifth rib is removed. A preliminary survey of the intrathoracic conditions can be made and the state of the hilum determined by palpation. If doubt exists or the condition appears operable, it is usually advisable to excise a segment of the posterior end of the supra- or subjacent rib to allow more adequate exposure.

Enlarged glands are almost invariably present, and it is by no means always easy to determine whether the enlargement is due to infection, secondary growth, or a combination of both. When the glands are enlarged by secondary growth, as is sometimes obvious, the ultimate prognosis is adversely affected, even when all visible glands are removed.

Lobectomy and Pneumonectomy.—In my opinion pneumonectomy should be carried out in every case where conditions permit. In no case of mine in which lobectomy has been performed for carcinoma has a patient survived over three years. When the close connexion between the lymphatics of the different lobes at the hilum is recognized it is easy to realize how impossible is the eradication of disease with a lobectomy, even when done by serial or anatomical dissection. The only justification for a lobectomy for bronchial or bronchiolar carcinoma is that the general condition of the patient is unlikely to result in a successful pneumonectomy, or that the state of the remaining lung will not permit efficient respiratory function if more than the minimum of lung tissue is removed. Even then it is dependent upon the situation of the carcinoma, and is applicable only to those cases in which the growth is sufficiently peripheral to allow of complete removal of the mass itself by lobectomy.

A further justification for lobectomy is for growths which are non-carcinomatous, such as endothelioma and possibly in the rarer cases of sarcoma. If bronchial adenoma is classed as a low-grade carcinoma, as is done in some of the American literature, and if its situation permits, it can be similarly dealt with satisfactorily by lobectomy.

The dissection procedure has been so well described as applied to lobectomy of the various lobes and to pneumonectomy that I shall only make one or two observations upon it. The first is that of exposure of the main pulmonary artery on the right side, which, when done by inward dislocation of the superior vena cava, entails some slight risk of opening the pericardium. My own preference is
CASE 4.—(2) Condition after A-P showing complete atelectasis of upper lobe, due to squamous carcinoma of bronchus, proved by bronchoscopic biopsy and successful pneumonectomy, surviving 2 years without symptoms.

CASE 5.—(1) Peripheral or bronchiolar carcinoma (squamous celled).
Carcinoma of the Bronchus

to ligate the superior branch at its origin from the main artery, deal with the bronchus, and then ligate the main artery just below the origin of the superior branch. On the left side the artery is more easily exposed and is tied immediately distal to the obliterated ductus arteriosus. In regard to the veins, when the growth involves them near the pericardium, they should be ligated within that structure. Even if a small opening is made into the pericardium, the latter should be left widely opened by extending the pericardial incision into the pleura at the end of operation.

The last problem is that of closure of the bronchus, and for this I have tried various methods. Inversion of the bronchus is liable to lead to partial obstruction of the remaining main bronchus, especially on the right side. This resulted in the death of one of my patients from pneumonia and atelectasis. Closure by mattress sutures of linen thread inserted parallel to the line of the bronchus and closure of the end by continuous thread suture leads in my experience to a proportion of the bronchi opening from the eighth day to three or four weeks after operation, with its accompanying risk of flooding of the bronchial tree with fluid from the pleura. It would appear that an abscess may form between the proximal mattress sutures and the distal continuous one, which eventually ruptures into the pleura and into the stump of the bronchus, resulting in a fistula. As a result, I have for the last two and a half years omitted the continuous suture and have covered the bronchus with pleura from the arch of the aorta or the arch of the vena azygos respectively, dividing the bronchus as near the trachea as possible. This method, in my experience, has resulted in a rapid, satisfactory, and permanent closure of the bronchus in every patient in the last two and a half years. In earlier cases sulphathiazole was used locally on the bronchial stump, but more recently a mixture of penicillin and sulphathiazole in the form of powder has been sprinkled on to the sutured bronchus. After the chest wall is closed in layers, 200–300 c.c.m. of air is withdrawn to allow the mediastinum to resume its normal position in the midline.

Post-operative treatment consists of the sitting posture in bed, the administration of the requisite amount of oxygen, and the control of pain by omnopon. Transfusion is continued slowly after operation if it is considered desirable.

Forty-eight hours after operation all fluid in the pleura is aspirated and sufficient air introduced to keep the mediastinum central in position. This procedure is repeated at intervals, gradually increasing in time until the end of the third month after operation. It appears to have the following advantages: (1) as in traumatic haemothorax it removes an excellent culture medium for organisms; (2) it prevents the intrapleural pressure becoming highly negative, and by more nearly equalizing the pressure on both sides of the suture line in the bronchus diminishes the risks of formation of a bronchial fistula; (3) should the bronchus open, it prevents the flooding of the bronchial tree of the remaining lung by fluid in the pleura.
Case 5.—(3) Four months after pneumonectomy.

Case 5.—(2) Tomograph of same condition—central cavity with thick walls.
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RESULTS

BRONCHIAL CARCINOMA

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<th>Procedure</th>
<th>Total cases seen</th>
<th>Private</th>
<th>Hospital (over)</th>
<th>Thoracotomy alone</th>
<th>Pneumonectomy</th>
<th>Lobectomy</th>
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Pneumonectomy

Survivals (34):

2 between 9 and 10 years
2 between 8 and 9 years
1 between 7 and 8 years
1 between 4 and 5 years
5 between 3 and 4 years
7 between 2 and 3 years
7 between 1 and 2 years
9 under 1 year

Deaths (32):

3 after 3 to 4 years—from metastases or local recurrence
2 after 2 to 3 years—from metastases or local recurrence
3 after 1 to 2 years—from metastases or local recurrence

24 deaths under 1 year

Deaths from recurrence, 12
Post-operative deaths, 12

Lobectomy

Survivals: 1 over 2 years

Deaths:
1 after 2½ years
1 after 2 years
1 after 1 to 2 years

ENDOTHELIOMA

4 cases—all treated by lobectomy
1 died after 2½ years from hyperpiesia
3 survive—1 after 18 years; 2 after 11 years

SARCOMA

3 cases—all ossifying
1 inoperable, treated by x-ray therapy, alive and well after 2½ years
2 cases treated by lobectomy:

(1) died following operation
(2) alive and well after 2½ years
Case 6—(2). After lower lobectomy.

Case 6—(1). Tomograph of amoebic abscess of right lower lobe showing thick wall closely resembling a breaking-down carcinoma.
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"Thoracotomy alone" represents the group of cases which, after routine investigation, show no contraindications to operation and yet on thoracotomy have proved inoperable. This number is diminishing, but will probably always remain relatively high in view of the difficulties likely to be encountered in making a really adequate and full assessment preoperatively.

In the group of "thoracotomy with radon" the operations were largely carried out before a satisfactory technique of pneumonectomy had developed, and during the period when the growth was explored and multiple radon seeds were introduced.

The "lobectomy" group is small and was carried out for those patients in whom the general condition of the patient or the condition of the other lung did not appear to warrant a total pneumonectomy.

Under the headings of "survivals" and "deaths" the figures are self-explanatory, except the 24 patients who have failed to survive one year. These have been subdivided into the two groups: (1) The post-operative deaths, in which the death was considered to result from the operative intervention or its complications, and largely represent the results in developing a satisfactory technique for operation and anaesthesia. During the last two and a half years no patient has died following pneumonectomy for carcinoma as a result of operation or its complications. (2) Deaths from recurrence within one year accounts for 12 deaths, some of which were due to further enlargement by growth of mediastinal glands that were beyond the limits of vision at operation, and which developed rapidly after operation, others from secondary deposits in the liver and brain. Many of these patients ran an otherwise inexplicable pyrexia.

The majority of late deaths are from similar causes, one between three and four years after operation being due to cerebral secondary deposits. In another case, a pneumonectomy was performed two months after a secondary deposit had been successfully removed from the brain. No difficulty was encountered with the lung operation, but within ten weeks further evidence of cerebral extension was evident.

The figures, taken as a whole, show that only a small proportion of cases of carcinoma of the bronchus reach the surgeon in time for radical operation.

It is evident, however, that the proportion of such operable cases is higher during the last three or four years than at an earlier period owing to more accurate diagnosis by the general practitioner. Moreover, owing to the insensitiveness of the lung to pain stimuli, a large residuum of patients will always present themselves with late symptoms such as pleural effusions or hoarseness of voice, due to recurrent laryngeal paralysis. The neglect of the symptoms of cough or even minor streaking of the sputum with blood by patients is also responsible, in so far as no doctor sees these patients until too late; although room for improvement is apparent in that in a proportion of patients radiologically examined the condition is not recognized, and many such patients are referred for further radiological examination two or more months later, when, while the diagnosis
Case 7.—(2) Condition after induction of artificial pneumothorax. (Radiograph slightly oblique.)

Case 7.—(1) Sarcoma of left lower lobe.
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may be more obvious, the outlook for the patient has deteriorated. Regular examination by mass radiography of the population at intervals of six months appears to be the only solution to diagnosis of all cases at an earlier period.

ADENOMA

No cases of adenoma have been included in the above figures, as the problem is an entirely different one. Although increasing experience suggests that such cases should be submitted to lobectomy when the situation of the tumour permits and to pneumonectomy when the smaller pulmonary resection will not include the tumour, the prognosis is quite different. These tumours, although potentially malignant and, in fact, showing in rare cases local infiltration or even spread into adjacent glands, occur in younger people, and more often in women than in men. The chief reason for their removal is the obstruction to the bronchus which their presence affords, and sepsis in the obstructed lobe or lung is the complication which can be avoided by their early removal. Many of them are sensitive to radium, and I have had several in which radon temporarily applied through applicators into the bronchus has caused the tumour to disappear, only to result subsequently in many cases in the formation of a stricture at the site. In one such case the secondary bronchiectasis required lobectomy three years after the disappearance of the tumour from the bronchus following radon application. With the risk that definite malignant change may occur in these tumours, radical treatment does not require further justification, but the distinction should definitely be made between operative treatment of these tumours and of the true carcinomas or other types of malignant disease. I should perhaps take the opportunity to acknowledge the fact that one case of carcinoma of the upper lobe published by me many years ago, in which a subtotal lobectomy was successfully performed, has been further examined and shown to be an adenoma. This patient still survived when last traced, 12 years after operation.

A few cases have been described as behaving primarily as an adenoma and subsequently becoming obviously carcinomatous. Of these, I have to record one case in a male patient of 61 years from whom it was possible to remove through the bronchoscope the whole small pedunculated tumour at one sitting. This patient was again bronchoscooped six months later, when no abnormality was found in the bronchial tree. Some three and a half years later he had further symptoms, was explored and found to have a large inoperable growth which had arisen, as seen by bronchoscopy, at the site of the previous adenoma. This suggests that true malignant changes take place in these tumours occasionally.

SECONDARY MALIGNANT DISEASE

Secondary malignant disease of the lung is usually demonstrable radio-graphically by multiple bilateral shadows in both lungs, clearly demarcated and causing little reaction in the surrounding parenchyma. Rarely, a single secondary growth is seen, and in such cases, if no further secondaries are demonstrable else-
where in the body, pulmonary resection is occasionally justified. It should be realized that in certain instances secondary growths occur in the bronchi, and unless a portion can be removed by bronchoscopy for microscopic section, there are no means of making an accurate pre-operative diagnosis distinguishing such cases from primary bronchial growths.

The following have been operated upon in the last 20 years:

1. **Palate and left upper lobe.** Squamous—upper lobectomy. Survived 15 months.
2. **Rectum and left lung.** Pneumonectomy—survived 15 months. Died from secondary deposits in the liver.
3. **Rectum and left upper lobe.** Wedge resection. Untraced after six months.
4. **Fibula and left upper lobe.** Subtotal lobectomy. Surviving and well 18 years later.
5. **Left lung and floor of mouth.** Secondary carcinoma and sarcoma combined—inoperable. Survived under six months.

**Radiotherapy**

In the early days before dissection, pneumonectomy was performed and, as a result of many abortive attempts to remove carcinomas of the lung satisfactorily by the tourniquet method, two methods of irradiation by radon seeds were
CARCINOMA OF THE BRONCHUS

devised. In some cases the seeds were inserted into the bronchus by introduction of a special container through the bronchoscope, were left in situ for several days, and then removed. Although canalization temporarily resulted through the bronchus in a proportion of cases, relieving the temperature, etc., caused by retained secretions, in no case of proved carcinoma was cure attained. Two cases of four years' survival proved subsequently to be adenomas and not carcinomas. In other cases, attempts were made by seeding the growth through a thoracotomy incision to arrest the growth. Some of these cases likewise showed considerable temporary improvement, but no cure.

X-ray therapy some years ago produced such general reactions as not to warrant submitting patients to the treatment, as so many were made more miserable than if left alone. In the last six years sufficient improvement has resulted to warrant the subjection of inoperable cases to this treatment with distinct hopes of amelioration of symptoms, disappearance of the radiological shadows in some cases, and prolongation of useful life. Nevertheless, I have yet to see a proven case of carcinoma of the bronchus cured by this measure for a period of three years, although a patient inoperable at thoracotomy five years ago still survives, having been treated for metastases on at least three occasions subsequent to the first course of treatment.

CONCLUSIONS

(1) Malignant disease of the lung appears to be increasing in incidence.

(2) A greater number are reaching the surgeon in an operable stage.

(3) The operative mortality has fallen from the neighbourhood of 50 per cent to 10 per cent or lower.

(4) Probably at the present time not more than 15 per cent of primary carcinomas of the lung are operable when first seen by a doctor.

(5) X-ray therapy carefully controlled will often ameliorate but never cure carcinoma of the bronchus.

(6) Pneumonecctomy by modern technique offers the only hope of cure.

(7) Lobectomy or pneumonecctomy is occasionally justifiable in the treatment of a solitary secondary malignant metastasis in the lung.

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