LUNG ABSCESS

BY

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INTRODUCTION

THIS monograph is based on a series of essays which appeared in the Guy's Hospital Reports between 1945 and 1948 and were conceived as a result of the study of the clinical, anatomical, and pathological features of the not inconsiderable number of patients with lung abscess whom I have seen and treated during the last twenty years. The actual number used for the various statistical analyses is 477. Much has been written about lung abscess but our knowledge is still far from complete, and it is certain that the knowledge that already exists is only indifferently disseminated.

Lung abscess is always a serious condition and in the management of cases, and in teaching, this gravity should be stressed. This is not because lung abscess is generally thought to be a mild condition, but because of the state of mind that tends to be engendered as a result of the wide acceptance of conservative treatment.

Because of the clinical and radiological demonstration of a formed abscess cavity in the lung the impression is again engendered that one is dealing with a clinical entity of 'lung abscess.' This is also an error and leads to a complacent grouping together of a number of conditions which are widely different in their causation, clinical course, and end result. It is one of the objects of this presentation to try and differentiate some of the types of lung abscess and to explain their varying aetiology and natural history.

It must be emphasized that a diagnosis of 'lung abscess' is insufficient. A lung abscess is almost always secondary to something else; it is much less often a true primary condition. It may be a clinical triumph and source of satisfaction to diagnose a difficult case conclusively as 'lung abscess,' for instance, as opposed to growth or empyema; it may be only too obvious that the patient has a lung abscess. In neither case must the diagnosis rest there, but must be followed to its logical conclusion; namely, what is the true primary cause of the abscess? It may, at times, be impossible to elucidate this primary cause or to be certain of it, but the search must be made. Unfortunately, complacency has again been engendered by the statement that a fair proportion, variously estimated, of lung abscesses are 'idiopathic.' In part this is true, but its acceptance stultifies all attempts to improve our knowledge of the condition. A special chapter will deal with this question of the diagnosis of the primary cause of lung abscess, but the principle is postulated now as it will be a guiding theme running through all the chapters.

I am greatly indebted to the Guy's Hospital Reports Committee for permission to make use of the blocks of the illustrations used in this book.

CHAPTER I

BRONCHO-PULMONARY SEGMENTAL ANATOMY

It is impossible to understand lung abscess without a clear knowledge of broncho-pulmonary segmental anatomy, and therefore an account of lung abscess must necessarily start with a description of this anatomy. It is almost axiomatic that the study of the disease processes of any organ or system must rest primarily upon a knowledge of the related anatomy and physiology. The modern approach to disease really dates from the time when the need for this exact study was generally realized and followed. The older anatomy of Galen was swept away by Vesalius; Harvey's physiological studies did the same for the mediaeval approach to function. The application of such basic methods in the study of the normal and abnormal led to the great advance of the succeeding centuries. It is remarkable that in the study of diseases of the lung a gap existed. It is true that the classic observations of Laennec and many others taught us a great deal about the pathology and clinical aspects of lung diseases, but the knowledge of pure anatomy on which this was based was incomplete; it dealt only with the gross structure of the lung, going no further than a consideration of the lobes as possible units. If less than the lobes were considered the descriptions and observations were to a great extent empiric because there was little or no ordered anatomy as a guide. In this respect the study of lung diseases may be fairly described as remaining in a mediaeval state. Towards the end of the nineteenth century the studies of Aeby and of Ewart began to draw attention to the more detailed anatomy of the bronchial tree, but it was not until the second quarter of the present century that a significant advance was made. This was the recognition of the importance of the broncho-pulmonary segment as a unit and a wide appreciation of the need for application of this segmental anatomy in the study and management of lung diseases. One reason, perhaps the chief, for this development was the rapid advance made in thoracic surgery. The white light of surgery illumines many dark places, and the need for more exact diagnosis before the serious step of operation is embarked upon encourages an exactitude and precision that is otherwise not found to be so necessary. As soon as the importance of this broncho-pulmonary segmental anatomy is grasped and it is consistently applied to the study and management of pulmonary disease a great deal of new information is inevitably revealed. It so happens that the suppurative diseases of the lungs depend to an unusually large degree on the anatomical arrangement of the broncho-pulmonary segments and, as already stated, it is not possible to study or understand these

diseases intelligently without a clear conception of this anatomy, which is of course also important in all inflammatory lung conditions. The recognition and general acceptance of the importance of broncho-pulmonary segmental anatomy is undoubtedly one of the great advances in the management of pulmonary diseases in this half-century.

It is not possible in this book to give a full account of broncho-pulmonary anatomy; this in itself provides the material for a book. For a fuller account the reader is referred to the various articles mentioned in the bibliography and to the series of papers written by the author in the Guy's Hospital Reports or to the book in which these papers were collected.

Nomenclature

Descriptions of the anatomy of the bronchi have been given by a number of authors during the last ten to fifteen years, and although there is fairly general agreement on the arrangement of almost all the chief branches, there have inevitably been differences in nomenclature as many authors have put forward their own scheme. The Thoracic Society recently appointed a sub-committee to draw up a uniform nomenclature, and soon after this the occasion of the International Congress of Otorhinolaryngology in London in July, 1949, provided an unusual opportunity to try and obtain agreement on an international plane; accordingly a representative committee was formed and a scheme approved by all was worked out. This was submitted to the Thoracic Society and was accepted; the agreed new international nomenclature was published as a report in *Thorax* in September, 1950. This new nomenclature, which will be used throughout this book, is shown in Figure 1.

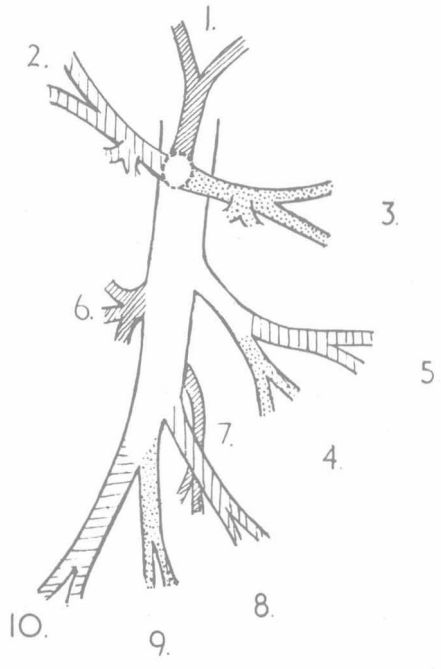
In order to help the simple identification of the chief segments each is allotted a number; it will be noticed that the absence of the medial basal (cardiac) bronchus and segment on the left means that there is no number 7 on that side.

It is wrong to consider the bronchi without the actual lung segments that they supply; these can be accurately demarcated by injection with a coloured solution of gelatin. In this way a pattern or map of the lung segments can be obtained (Figures 2 and 3).

The diagrams depict the average general position, shape, and size of the segments, but there are naturally variations from case to case. For instance, the anterior segment of the right upper lobe may be larger at the expense of the posterior segment, or vice versa. Allowing for such variations, the pattern is conformed to often enough to be accepted as a standard.

It will be noted that lateral and medial views alone have been used in these diagrams; this is in marked contrast to the habit, still only too common, of relying solely or chiefly upon postero-anterior radiographs of the lungs for study. Each lung is far wider in its lateral view than in the postero-anterior,

RIGHT LATERAL



UPPER LOBE

1. Apical bronchus
2. Posterior bronchus
3. Anterior bronchus

MIDDLE LOBE

4. Lateral br.
5. Medial br.

LINGULA

4. Superior br.
5. Inferior br.

LOWER LOBE

6. Apical bronchus	6. ditto
7. Medial basal (cardiac) br.	
8 Ant. basal br.	8. ditto
9. Lateral " ".	9. ditto
10. Post. " ".	10. ditto

LEFT LATERAL

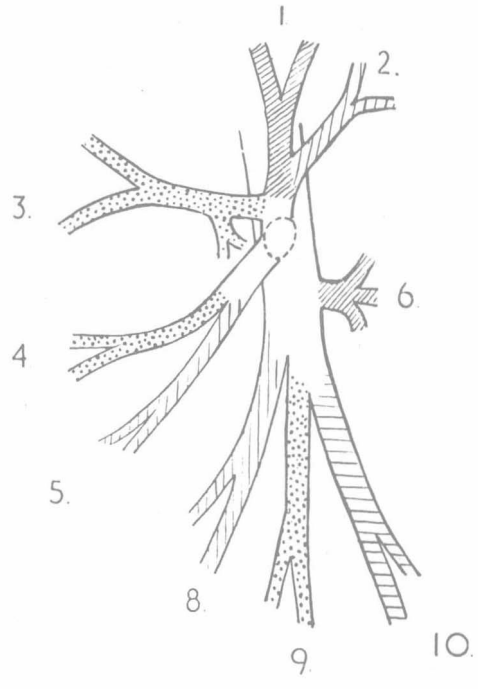


FIG. 1. The nomenclature of the bronchial tree.

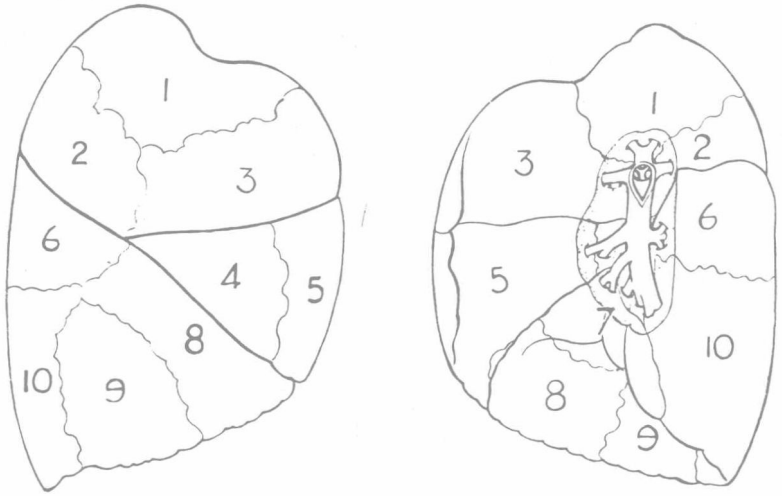


FIG. 2. The segments of the right lung.

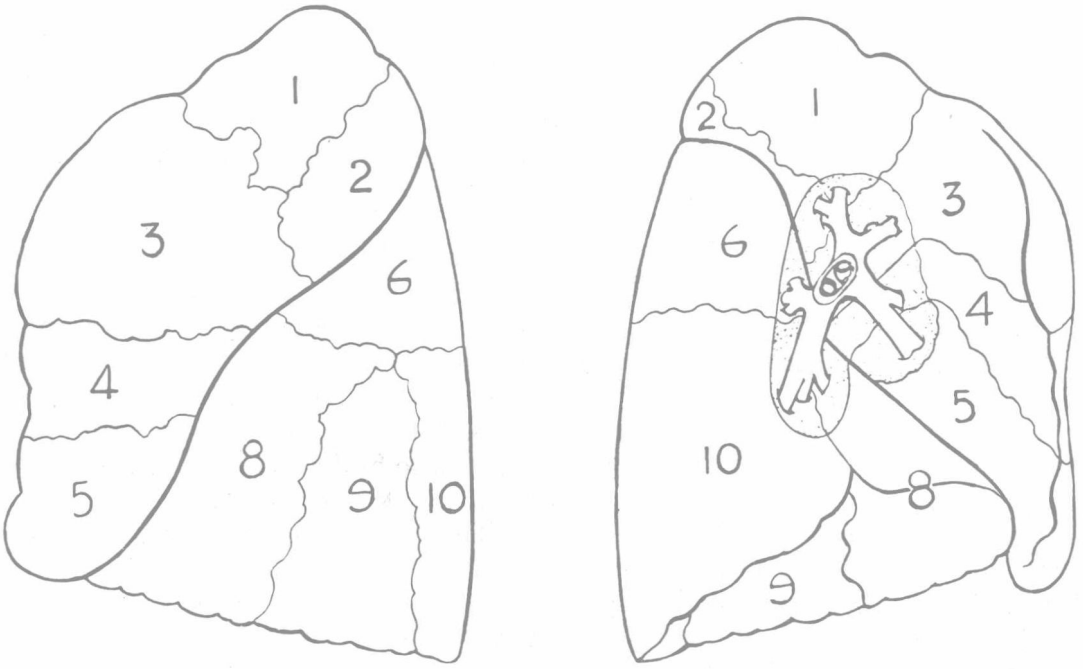


FIG. 3. The segments of the left lung.

even though the total width of the chest may be wider. For this reason alone the radiological study of the lungs and bronchi would be incomplete without

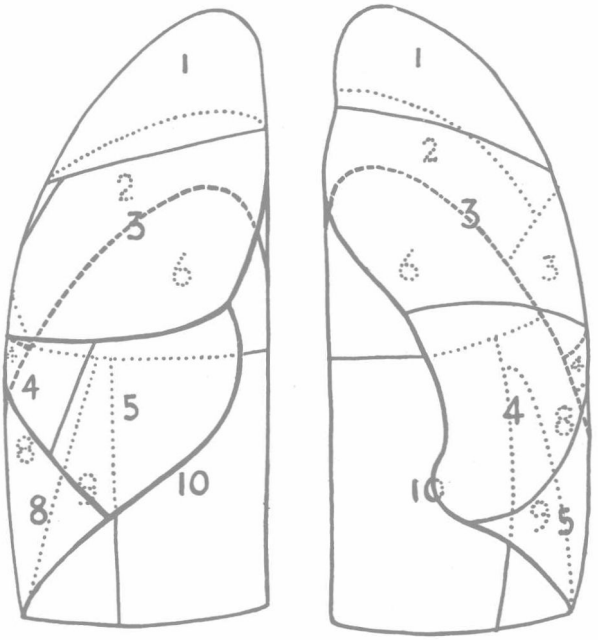


Fig. 4. Antero-posterior diagram of the segments to illustrate overlap and confusion.

lateral as well as postero-anterior views. More important still is that the lateral views avoid the considerable overlapping and confusion that occurs in a postero-anterior radiograph. This is well shown in the diagrams of the segments in Figure 4. The same overlapping is also seen in postero-anterior bronchograms, whereas in the lateral view the bronchial anatomy is seen quite clearly (Figures 25*b* and 27*d*).

The indispensability of good lateral as well as postero-anterior radiographs is now widely recognized, but it is still only too common to find radiologists giving a report on a lung lesion from a postero-anterior film alone and, what is even more disturbing, to find clinicians accepting such incomplete examinations and reports. It is by no means uncommon to find a case of lung suppuration has been observed over a course of many weeks, or even months, without a single lateral radiograph being taken. This failure of appreciation of the need for *exact anatomical localization and anatomical study* of the lesion as the first step in diagnosis is really a perpetuation of the mediaeval approach to medicine and surgery already mentioned. It is impossible to approach diagnosis and management intelligently until exact localization has been considered. For this reason the use of such loose terms as 'upper zone,' 'middle zone,' and 'lower zone' is to be deprecated.

If radiological opacities are studied in this way on the basis of the standard arrangement of the broncho-pulmonary segments it will be found that it is common to be able to recognize that a particular segment is accurately demarcated; Figures 5 and 6 show examples of this. It is possible to illustrate examples of typical lesions of every segment in the lungs, but space prevents this. A full account will be found in the book already mentioned (Brock, 1946). Once this principle has been grasped it will be found that with practice and a simple application of anatomical knowledge a whole flood of light is thrown on the radiological and clinical study of lung diseases, especially the suppurative group. Difficulties and sometimes confusion occur from ill-defined lesions, from multi-segmental lesions, or from overlap or irregularities, but these will not affect the main principle, and at any rate should serve to stimulate effort to elucidate them.

The advantages to be derived from this approach to lung suppuration on a segmental anatomical basis are:

1. The ability to localize the lesion to its exact anatomical site.
2. The indispensable value this has in differential diagnosis.
3. The confidence engendered by the knowledge that one's approach is more exact and specific and not empiric.
4. The fuller observation of the natural history and pathology that is rendered possible.
5. The inevitable advance in basic knowledge that ensues.
6. The proper prescription of postural drainage or of topical therapy within the bronchial tree.
7. The assessment of the exact external operative approach to a lung abscess.

CHAPTER II

THE PATHOLOGY OF LUNG ABSCESS

LUNG abscess is essentially an acute suppurative pneumonitis which may proceed to a greater or lesser degree of gangrene. All gradations of gangrene occur, presumably due to variations in the resistance of the host and the virulence of the infecting organisms. As the process that gives rise to the abscess is suppuration occurring in an area of pneumonitis, it is necessary to consider how this area of pneumonitis arises. Because gangrene is such an important feature the question of arterial embolism as the primary cause is inevitably raised. Although this must occasionally happen, it is doubtful if it is the process in all but a few cases. The primary event is almost certainly *bronchial embolism* by some substance that carries with it organisms, anaerobic or aerobic (often mixed or symbiotic), and frequently of the types commonly found in the mouth and nasal passages. This embolism sets up an acute segmental or subsegmental pneumonitis which, presumably by causing secondary vascular thrombosis or by direct toxic action upon the lung tissue, gives rise to gangrene of the lung. Cutler and Schluetter (1926) and Cutler (1927), from experimental studies on dogs, have shown that a lung abscess could be caused only if both bronchial *and* vascular embolism was instituted. It is not possible to correlate their observations with the condition as it occurs in man.

Bronchial embolism and posture

It is one of the chief postulates of this monograph that the commonest mechanism in the production of lung abscess is *bronchial embolism*. This matter has been fully considered and discussed in a previous communication (Brock, Hodgkiss, and Jones, 1942). One of the most pertinent and conclusive facts in the evidence is the occurrence of abscess in certain sites in the lung which are peculiarly favourably placed to receive inhaled material in certain common postures. If a careful anatomical assessment is made of the segmental localization of inflammatory lung lesions (tuberculous as well as non-tuberculous, before continued spread has obscured the picture), it will be found that certain segments are much more commonly involved than others. The first of these is, undoubtedly, the posterior segment (segment 2) of the right upper lobe (Figure 5); the same segment on the left side is less often affected. This posterior segment of the right upper lobe can unhesitatingly be named as the most important segment in the lungs. Next in order of frequency is the apical segment of each lower lobe (segment 6, Figure 6). It is not uncommon to see segments 2 and 6 affected together, or consecutively.

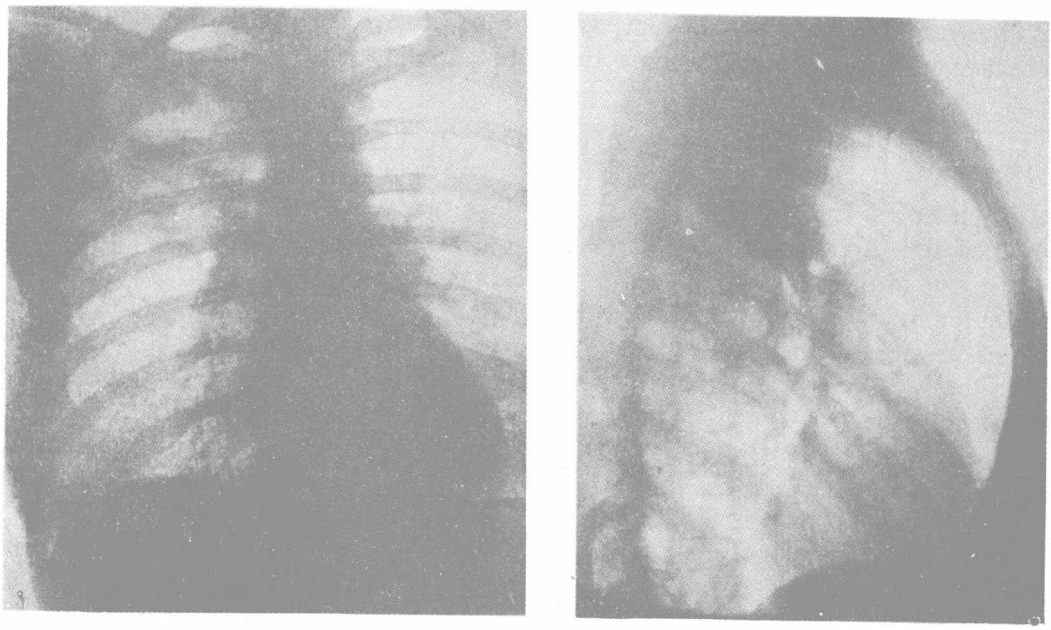


FIG. 5. Abscess of the posterior segment, right upper lobe. In the postero-anterior view it is not possible to localize the segment involved. In the lateral view the diseased posterior segment can be identified.

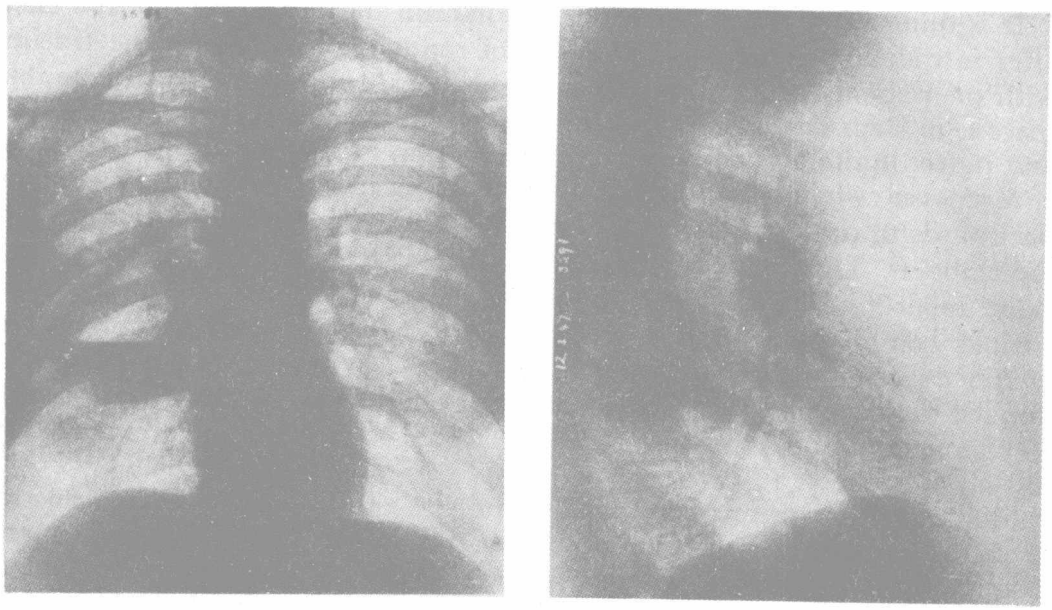
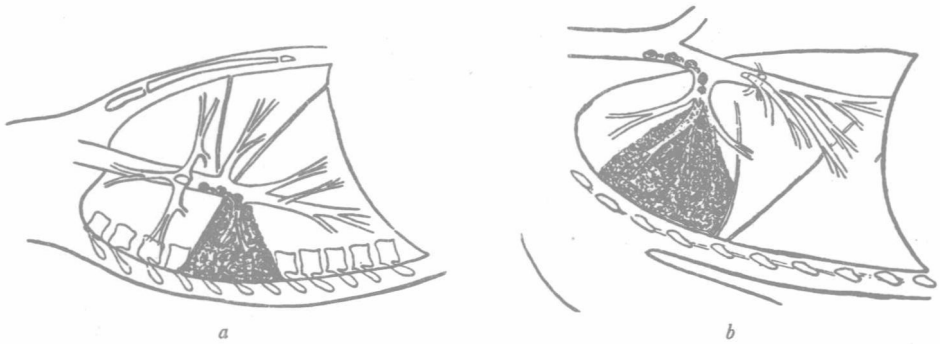


FIG. 6. Abscess of the apical segment of the right lower lobe.

These are observations of fact, and the most satisfactory explanation of the occurrence is simple and shows the cause to be the distribution of inhaled



a *b*

FIG. 7. To show the suggested relationship between posture and the focal incidence of lung abscess. When the patient is lying on his back (Figure 7*a*) the apical part of the lower lobe is vulnerable, and when lying on his side (Figure 7*b*) the lateral and posterior part of the upper lobe is affected.

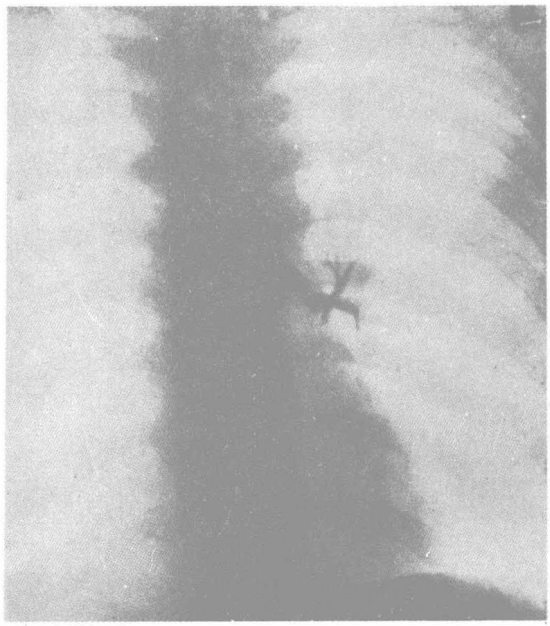
material within the bronchi (bronchial embolism) as a result of gravity and posture.

Thus, if a patient is lying on his back when material enters the bronchial tree the first bronchus favourable for its reception is the apical bronchus to the lower lobe (Figure 7*a*). If the subject is lying on his side, the upper lobe bronchus is similarly most favourably placed to receive the embolism (Figure 7*b*).

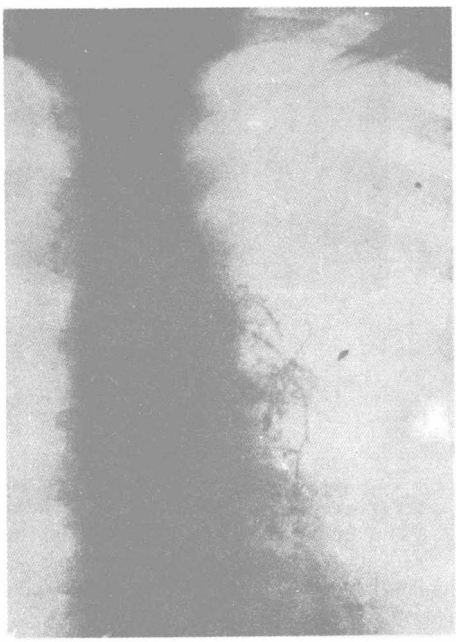
It is quite simple to confirm this mechanism by radiography of the chest after introduction of a small quantity of radio-opaque oil into the trachea with the patient lying on his side or on his back. Figures 8 and 9 show that the oil, in such circumstances, gravitates *at once* to the segments mentioned. and indeed quite a good selective bronchogram is obtained.

Moreover, when the subject is on his side he may lie rotated forwards or backwards to a varying degree. This also will affect the site of reception of the embolus. Figure 10 is a diagram, but the disposition of the bronchi of the right upper lobe is drawn accurately from a metal cast. It will be seen that various combinations of lesions can occur, *and all of these are observable in practice and can be demonstrated time and time again.* With this simple knowledge applied to the radiological and clinical study of lung suppuration it is possible to understand a great deal that hitherto would have been obscure, meaningless, or empiric.

Similar, although less common but no less precise, examples of selective bronchial embolism may be observed throughout the lungs and many examples will be given in the later chapters. If this principle of the part played by posture and gravity in bronchial embolism is accepted and applied whenever possible it will be found to pay handsome profits in achieving, quite



a



b

c

FIG. 8. Lipiodol injected with the patient lying on his back has entered the apical bronchus to the left lower lobe. Figure 8*a* was taken after thirty seconds; Figures 8*b* and 8*c* after five minutes.