BRONCHIECTASIS IN CHILDHOOD.

Its Symptomatology, Course and Cause.

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INTRODUCTION.

There are three conditions, viz :—bronchiectasis, chronic or unresolved pneumonia, and pulmonary tuberculosis, which have always given, and still do give rise to difficulty in their differentiation. Until recently the finding of the tubercle bacillus has been our chief, if not our only aid, in this differentiation, though from a knowledge that such is not always positive many cases of bronchiectasis and simple chronic pneumonia, at least in childhood, have been certified as cases of pulmonary tuberculosis and admitted to Sanatoria. It might be thought that with the advent of radiology great assistance would have been rendered in this direction, but when we recall that any consolidation of lung tissue will obstruct the passage of the X-rays and cast a shadow the limitations of this method of examination will be apparent. Nevertheless, if one appreciates the usual course of pulmonary tuberculosis during childhood, X-ray examination of the chest does give considerable help.

Pulmonary tuberculosis as it is met with by the pædiatrician is on the whole a disease of infancy and very early childhood, an acute or subacute ailment leading comparatively quickly to a fatal result, and, unless in the very early stages, involving both lungs. Chronic pneumonia and bronchiectasis, on the other hand, are met with as a rule during later childhood, are eminently diseases of long duration and usually, though not invariably, limited to one lung or one lobe of a lung. Hence the extent of the mischief in relation to its duration and the age of the patient may enable one to speak fairly definitely for or against tuberculosis.

Within recent years, however, Sicard and Forestier⁽¹⁾ have shown that it is feasible to introduce into the bronchial tree a substance (iodized oil—lipiodol) which is impervious to the X-rays. By this procedure it is possible to demonstrate the conformation of the whole bronchial tree and to discover if the bronchi, as in health, gradually taper towards their distal extremities or whether bulbous or tubular dilatations are present along their course. It is on the basis of our experience with this method of investigation of cases of chronic pulmonary disease in childhood, and the results obtained, that the present communication is founded. In our discussion of the question we wish to limit our attention to the matter of diagnosis and cause of the malady, and to the condition as met with during childhood. In view of the fact that many authorities are agreed that the onset of the disease, or at least the chronic pneumonia which is one of its main causes, is most frequent during childhood this limitation of the field of study does not produce such a one-sided view of the subject as might at first sight appear. In perhaps the largest series of cases of chronic pneumonia and bronchiectasis, which was recorded by Clark, Hadley and Chaplin^(1a), 82% of 45 cases had their origin before 8 years of age.

DIAGNOSIS.

Physicians have been familiar with the condition of bronchiectasis ever since Laennec first described it in his classical work entitled "De l'auscultation" published in 1819⁽²⁾. Laennec gives an almost perfect description of the symptoms and naked eye appearances and he records in detail two well-marked examples. These two cases occurred at the two extremes of life and illustrate some of the most characteristic features of the disease. One case was that of a child of three years who contracted whooping cough and in whom the cough persisted for six to twelve months, the child dying during one of the paroxysms of coughing. The other was a maiden lady of 72 years who had suffered for at least 50 years from a malady of the chest characterized by cough and purulent spit and frequent hæmoptysis. Though these symptoms suggested pulmonary tuberculosis she was quite able to attend to her labours as a teacher of the pianoforte, was well formed and did not emaciate. Death ensued comparatively rapidly at the end with severe dyspnœa and œdema. In the child, fibrosis of the left lower lobe and bronchiectasis were found at the post-mortem examination. In the adult, fibrosis and numerous cavities with smooth walls communicating with the bronchi were found in the right upper lobe: in the right lower lobe there was also some slight dilatation of the bronchi, as also in the left upper lobe, but in neither of these lobes were there any definite cavities: the left lower lobe was quite free and the heart appeared healthy.

Laennec gave as the characteristic clinical picture a disease of long duration accompanied by severe fits of coughing, abundant muco-purulent spit and pectoriloquy audible at some part of the chest, but unattended by fever or emaciation. Curiously he makes no mention of amphoric breathing to which nowadays so much attention is paid and which is often a most characteristic feature, especially when searched for after emptying the bronchiectatic cavities by inverting the patient and getting him to cough—the so-called posturing. The first writer apparently to draw attention to amphoric breathing was Andral⁽³⁾ who, when describing a case in 1824, says that "a species of bronchial respiration occurred as if the individual was blowing strongly at the extremity of the cylinder."

When the symptoms and signs are present in their classical form the diagnosis is easy, but most authors admit that a complete picture seldom obtains and hence the frequent difficulty in diagnosis. In fact during the last 100 years little change is to be observed in the attitude of different writers when discussing the question of differential diagnosis, so that Laennec writing in 1819 is as modern as Fowler⁽⁴⁾ writing in 1898 or Ewart⁽⁵⁾ in 1909. This simply depends on the fact that dilatation of the bronchi does not always produce signs or symptoms and that there has been no method by which during life a bronchial dilatation could be definitely demonstrated. Armand Delille⁽⁶⁾ who has perhaps within recent years written most extensively on the question, at least in childhood, groups the cases under two headings: (a) those with typical symptoms—cough, spit, pulmonary dullness and amphoric breathing, and (b)

those with typical symptoms having the manifestations of bronchitis or recurrent colds or perhaps no symptoms at all, as when the condition is suggested from the appearances accidentally discovered during a radiological examination of the chest. In Delille's opinion the majority of cases in childhood belong to the second group. Delille also draws attention to the fact that physical signs of bronchiectasis may be present while lipiodol injection may reveal a normal calibre of the bronchi.

Like most clinicians we not infrequently had met with the greatest difficulty in arriving at a definite diagnosis. From the collation of our clinical and post-mortem material we had become fairly confident in the recognition of tuberculous lesions, even although tubercle bacilli could not be isolated from the sputum. As previously mentioned the age of the patient, the rapid course of the disease and the fact that X-ray examination usually revealed mischief in both lungs, and much more extensively than was evident by physical examination, were all points which helped us to separate the tuberculous examples from other chronic pulmonary lesions. And from the not infrequent and unexpected finding on the post-mortem table of bronchiectasis in cases which had been diagnosed as chronic pneumonia we were coming to believe that these two conditions were always co-existent, and that chronic pneumonia and bronchiectasis might be used as synonymous terms. It was consequently with the greatest interest that we availed ourselves of the help of the intratracheal injection of lipiodol to test our views on this question. As the result of this experience we have modified our opinion that chronic pneumonia is invariably accompanied by bronchiectasis, although we still hold that such is usually the case. We have also learned to appreciate with Delille that in not a few instances the latter condition may be present though there are no signs of its existence, and further, that both signs and symptoms may definitely point to its presence when there is absolutely no dilatation. From our premature confidence in the reliability of physical signs we at first were inclined to the view that the use of lipiodol would be chiefly of academic interest and not necessary for formulating a diagnosis, but we now feel that this method of examination is really essential, not only for arriving at a diagnosis, unless in those cases where the classical symptoms are present in their most typical form, but also to demonstrate the full extent of the disease.

Before reviewing our conclusions regarding the signs and symptoms and clinical course of the disease from an analysis of all the material which has come under our notice we have considered it advisable to give in the first place detailed histories of several contrasting cases. In this way our point of view will be best exemplified and the help given in diagnosis by the intratracheal injection of lipiodol demonstrated.

CASE 1. The first case was a boy who came under observation in 1914 at the age of $4\frac{1}{2}$ years with a history of cough and fever and loss of flesh of one month's duration. On admission to hospital the left side of the chest, both back and front, was dull to percussion, with the R.M. tubular towards the apex and very deficient towards the base. X-ray examination revealed

mottling throughout the whole of the left lung. Irregular intermittent fever persisted throughout his residence of three months in hospital, but with little change in the physical signs. On several occasions owing to the density of the dullness and marked deficiency of the R.M. fluid was suspected and the chest was explored but always with negative result. Sputum was also obtained on several occasions but tubercle bacilli were never found. The diagnosis wavered between chronic pneumonia, empyema and pulmonary tuberculosis and when he died suddenly one morning, 4 months after the onset of the illness, from a most severe hæmoptysis, tuberculosis was thought to be the most probable lesion. At the post-mortem examination the left lung was found shrunken and adherent all over with the surface like that of a cirrhotic liver. On section the interlobular fibrous tissue was seen to be greatly increased in amount and enclosing cavities with caseous looking walls which histological examination revealed to be dilated bronchi. The hæmorrhage had apparently arisen from one of the larger cavities at the extreme base of the lung. The right lung was very emphysematous. No evidence of tuberculosis was discovered anywhere.

This case occurred before the use of lipiodol had been advocated and before we had formulated our ideas regarding the clinical features of chronic pneumonia and the frequency of pulmonary tuberculosis at this age period. The picture, however, was typical of unresolved or chronic pneumonia, and, with the exception of the persistent cough, there was no sign or symptom usually considered characteristic of bronchiectasis. It was this case and several almost exactly alike in symptomatology which had led us to consider bronchiectasis and chronic pneumonia as one and the same pathological entity.

The following case (Case 2) is one with a somewhat similar history to that above detailed, but differs in that we were ultimately able to avail ourselves of the help of lipiodol injection.

CASE 2. An illegitimate boy *aet.* 8 months was admitted to hospital with a history that six weeks previously cough, fever and dyspnoea had developed and that on being seen by a doctor pneumonia had been diagnosed. He seemed to improve after a little but one week ago cough and dyspnoea returned. On admission to hospital there was no fever but the breathing was rapid and grunting in character; there was dullness to percussion all over the left side of the chest with an intensely tubular R.M. all over the left back and in the left lateral region. X-ray examination showed a shadow throughout the left side of the chest with the heart pulled to the left and a suggestion of cavitation or clearing at the apex.

The further course of the illness was characterized by an almost complete absence of fever, persistence of physical signs of consolidation of the left lung and possible cavitation at the apex suggested by the occasional amphoric nature of the breathing and the X-ray picture. Tubercle bacilli were not found in the sputum examined on several occasions. Though the physical signs did not suggest fluid its presence was regarded as not improbable by the radiologist and the chest was explored but with negative result. The case was looked upon as one of chronic broncho-pneumonia and treated with a mixed influenza bacillus vaccine without any apparent benefit. He remained in hospital for two months and was then sent to a convalescent home where he remained for a further period of four months. During this time he had comparatively little cough and no fever. He steadily increased in weight, but the physical signs remained unchanged except that the apex seemed clearer to percussion and on examination with the X-rays. He was re-admitted to hospital eleven months later when aged 2 years for further investigation. The mother stated that cough was still present being specially severe in the morning when it might continue for as long as an hour at a time. There was no spit. Only once during the interval had he had any manifestations of acute illness when he suffered from fever with dyspnoea and respiratory dilatation of the nostrils for one day. The child had grown and learned to walk and run about and play. On re-admission he looked a fairly healthy boy and his height was only 2 cms. below Holt's average. The left side of the chest was slightly flattened and dull to percussion, both back and front, with definitely amphoric R.M. at the angle of the scapula.

10 cc. of lipiodol were injected into the trachea through the crico-thyroid membrane and an X-ray photograph taken immediately afterwards revealed dilatation of the bronchi throughout the whole of the left lung. (See Fig. 1).

In the next case (Case 3) the history, signs and symptoms were classical and the lipiodol injection fully confirmed what was anticipated.

Fig. 1.—Case 2. Extreme degree of tubular bronchiectasis throughout whole of left lung.

CASE 3. A. McM., a girl, came under observation on October 2nd, 1924, at the age of 7 years on account of a persistent cough and profuse yellow spit. She had had pneumonia after measles when twenty-one months old and since then cough and spit had been present, and although varying in severity had on the whole got worse. At times blood was present in the sputum. She had been resident for six months in a sanatorium at the age of 5 years because she was supposed to have pulmonary tuberculosis.

She was an undersized child with a height of 106.5 cms. and a weight of 13.4 kilos. Her colour was good but fingers and toes were clubbed. Von Pirquet's tuberculin reaction was negative. The cough was very troublesome and came on after the least exertion, and the sputum, which seemed to be brought up in mouthfuls, varied in a day between 2 and 5 ozs. The sputum consisted of liquid greenish pus and was devoid of all odour. The left side of the chest was flattened and dull to percussion in the lateral region and over the back below the angle of the scapula: the gastric crescent was on a level with the 5th rib and the heart was drawn over to the left with the apex beat in the 5th space $4\frac{1}{2}$ ins. to the left of mid-sternum. The R.M. was tubular at the apex and deficient at the base. After "posturing" and evacuation of about $\frac{1}{2}$ oz. of liquid pus the dullness at the left base was less intense, the R.M. became amphoric and whispered

pectoriloquy was audible in the region of the angle of the scapula. X-ray examination of the chest showed a distinctly "honeycomb" shadow in the lower half of the left chest and after lipiodol an extreme degree of saccular dilatation of the bronchi in the left lower lobe. (Fig. 2).

The following case (Case 4) is one in which the symptoms were as equally characteristic as in the preceding case, but the physical signs were not commensurate with the extent of the mischief.

CASE 4. R.R., female aged 13 years, came under observation, Sept. 6th, 1926, with the complaint of cough since the age of one year. She had bronchitis at one year of age, broncho-

Fig. 2.—Case 3. Saccular bronchiectasis in left lower lobe.

pneumonia at twenty months and again at two and a half years, since when the cough and spit had been specially troublesome. The cough was most frequent in the morning and was accompanied by a profuse yellow spit. She was a healthy looking girl only very slightly under height and weight, measuring 152 cms. and weighing 37 kilos. She had a good colour and there was no clubbing of the fingers. The cough was very troublesome and was induced by the slightest movement when she would expectorate a large amount of a yellow but odourless sputum. The von Pirquet tuberculin reaction was negative. Physical examination of the chest revealed defective movement of the left side with some harsh and dry râle and a tubular R.M. just below the angle of the scapula. There was little or no change in the signs after posturing and expectoration of some muco-pus. X-ray examination of the chest showed little else than increased root

shadows. After injection of lipiodol, however, an X-ray photograph revealed marked dilatation of the bronchi in both lower lobes, but more extensive on the left side. (Fig. 3).

The next case (Case 5) is one in which both signs and symptoms were indefinite but lipiodol revealed very definite bronchiectasis.

CASE 5. A.T., a female, aged three years and ten months, came under observation Oct. 7th, 1925, with the complaint that for two years she had had a cough which during the last nine months had been accompanied by a yellow spit. She had measles at one year and pneumonia at two and a half. The cough had been present since the attack of measles and the spit since the attack of pneumonia. During the night, but especially on waking in the morning, the child was subject to fits of coughing when she brought up about one drachm of a yellowish spit. Otherwise she appeared perfectly well. She was a healthy looking child of normal height (97 cms.) but

Fig. 3.—Case 4. Tubular bronchiectasis in both lower lobes.

slightly under weight (13 kilos). The von Pirquet tuberculin reaction was positive. Examination of the chest revealed an impaired percussion note over the right front below the nipple and in the left lateral region. The R.M. was tubular at the angle of the left scapula and was accompanied by much moist râle. After inversion and coughing, one half drachm of a greenish spit was obtained without change in the physical signs. X-ray examination of the chest revealed a doubtful fibrosis at the left base. Lipiodol demonstrated that the bronchi in both lower lobes, but especially in the left, were definitely dilated.

The next illustrative case (Case 5a) is one in which the history, signs and symptoms were as suspicious as in the preceding and from our previous experience of chronic pneumonia, we were prepared for bronchiectasis. Yet lipiodol did not reveal bronchial dilatation.

CASE 5A. M. McL., girl aged six years, admitted with a history of a cough which had been present since whooping cough two years previously. The cough was mainly during the night and on waking in the morning when she would frequently bring up yellow sputum. Six months ago the tonsils were removed without benefit to the child's general condition.

She was small, but well nourished; healthy looking; measured 106 cms. and weighed 14.3 kilos. There was dullness at the left base behind with high pitched and tubular R.M., almost amphoric at the angle of the scapula. Whispered pectoriloquy was well marked at the left base. The X-ray picture revealed a slight shadow at the left base. After the injection of lipiodol no dilatation of the bronchi could be made out and it was seen that the lipiodol had entered many of the alveoli giving a finely powdered appearance. (Fig. 4). (Compare with Fig. 5, which was also obtained in a case simulating in history and physical signs bronchiectasis.)

Fig. 4.—Case 5a. Appearance of lipiodol in alveoli. No bronchiectasis.

Finally the subsequent case (Case 6) is one in which there were neither symptoms nor signs of the condition and yet post-mortem examination revealed extensive dilatation of the bronchi in both lower lobes.

CASE 6. The patient was a girl (I. H.) who came under observation on August 8th, 1924, at the age of six and a half years with double pleural effusion, first on the left side and later on the right, and a positive von Pirquet reaction. From this illness she gradually recovered and remained in good health for some months. On February 16th, 1925, she complained of pain in the eyes but continued to go about as usual. On February 18th she developed severe occipital headache, became fevered in the evening (the temperature registering 103° F.) and was very restless during the night. Next day she vomited frequently and was delirious, and on the following day became unconscious. On admission to hospital on Feb. 21st, she was unconscious, restless, with marked retraction of the head, temperature 104° F., pulse-rate

124, respiration-rate 28, and double optic neuritis. Physical examination was otherwise negative except for some impairment of the percussion note at the right base where the R.M. was slightly defective. Lumbar puncture gave a turbid fluid with a sediment containing 70% polymorphs. No organisms were seen in films or grown by culture. In view of the history of the previous pleurisy and the positive tuberculin test the case was considered one of tuberculous meningitis. The child remained in the same state and died quite suddenly four days later.

At the post-mortem examination both lungs were found adherent, the adhesions being specially dense on the diaphragmatic surfaces. Both lungs were sclerosed and showed uniform dilatation of the larger bronchi, with thickened mucosa and numerous small pockets in their walls. At the

Fig. 5.—Normal bronchial tree in a case of slowly resolving pneumonia.

base of the left lung adjacent to the diaphragmatic surface was a patch of special density about one inch square containing several definitely caseous foci. The glands in the mediastinum were enlarged and caseous: one at the root of the right lung was softened, and its pus contained streptococci and pneumococci but no tubercle bacilli. In the abdomen there was evidence of a chronic plastic peritonitis with a few enlarged and caseous mesenteric glands. On opening the calvarium a small amount of purulent exudate was found over the vertex of the brain and posterior surface of the cerebellum with congestion of the meninges and some flattening of the convolutions. On cutting into the brain numerous small abscesses varying in size from that of a pin's head to that of a small nut were found scattered throughout both the grey and white matter. A hæmolytic streptococcus was cultivated from the pus in the cerebral abscesses and from the exudate on the surface of the cerebrum.

ANALYSIS OF SIGNS AND SYMPTOMS.

It will be evident from the foregoing case-histories which reveal so varying a symptomatology and clinical picture that the diagnosis of bronchiectasis is not always easy and that mistakes are apt to occur if one depends on ordinary physical examination. Hence in the following review of the symptomatology we have only included cases in which the condition was verified either by the use of lipiodol injection, by operation, or at a post-mortem examination.

AGE INCIDENCE AND DURATION.

In all we have had under observation 23 definite examples of bronchiectasis. Ten of the children were boys and thirteen girls. In age the children varied at the time of observation between twenty months and thirteen years, and the age at onset of the condition varied between seven months and ten years and four months. The duration of the ailment from the time of onset to the time of observation or death varied between three months and twelve years. In four cases the duration was less than one year, in four cases between one and two years, in two cases between two and three years, in three cases between three and four years, in three cases between four and five years, in four cases between five and six years, in one case seven years, in one case eight years and in one case twelve years.

EXCITING CAUSE.

In all but three cases the condition could be traced to some acute pulmonary disease. In these three cases no history of an acute onset could be obtained, the story being simply that the children began to cough and spit. Simple broncho-pneumonia was responsible for eight cases, lobar pneumonia for two, pleurisy for two, bronchitis for one, measles for one, measles and broncho-pneumonia for one, influenza for one, whooping cough for two, whooping cough and broncho-pneumonia for one, and the combination of measles and whooping cough for one example. Not infrequently the initial pulmonary infection was described as severe, lasting for several weeks, and though the child did ultimately improve complete health had never been regained, cough with intermittent expectoration persisting. It is a curious fact that in spite of the frequency of the condition (we ourselves have observed fourteen cases during a period of two years—1925 and 1926) practically all writers on chronic pneumonia and bronchiectasis remark that they have never seen a case develop out of any acute pneumonia which they themselves had treated. This is all the more remarkable when one recollects how slow resolution often is both in lobar and broncho-pneumonia. We have been fortunate in observing three cases almost from the beginning (Cases 1, 2 and 6 reported in detail above), and in none did the illness seem specially severe. True, in one case (Case 6) there was the unusual occurrence of double pleurisy with effusion, but in the other two instances, one of broncho-pneumonia and the other of seeming lobar pneumonia, the initial illness was not specially severe. It was always the delayed resolution which caused anxiety. In the supposed example of lobar

pneumonia, fever, for the most part intermittent in character, persisted throughout, whereas the course of the broncho-pneumonia was afebrile during the time the child was under observation, and he seemed quite comfortable. In no instance was there a history that the insufflation of a foreign body gave rise to the condition. In our experience abscess of the lung and not bronchiectasis has resulted from the insufflation of a foreign body, e.g., a piece of tonsil during the operation of tonsillectomy.

NUTRITIONAL STATE.

Laennec gave as one of the cardinal features of the disease, chronicity without marked impairment of the general health. This certainly is one of the most striking characteristics of bronchiectasis. In spite of the cough and profuse expectoration continuing for years the children appear wonderfully healthy and of good colour and nutrition. Almost invariably, however, they are under height and weight for their age. In three cases the children were over height to the extent of 0.3, 2.0 and 6.6 cms., but on the average they were 7.9 cms. below Holt's standard. The loss in height did not seem to bear any relationship to the duration of the illness as the child who was 6.6 cms. over height had been ill for five years, and the child 2 cms. over height had been ill for twelve years. One child was 29 cms. below height and had been ill for seven years; another child was 22 cms. under height and had been ill for six and a half years; two children 13 cms. under height had been ill for three and a half and one and a half years respectively.

All the children were under weight, but on the average not to the same degree as they were under height, and it is this fact which accounts for the good nutritional appearance. The average loss in weight in twenty of our cases was only 5.58 kilos. whereas, as stated above, the average loss in height was 7.9 cms. The greatest retardation of weight was 17.7 kilos, in a child who had been ill for seven years—this child was 29 cms. under height. The child who had been ill for twelve years was only 4 kilos. under weight and another child ill for three and a half years was 8.8 kilos. under weight.

CLUBBING OF THE FINGERS.

In eleven of the cases there was clubbing of the fingers and in eleven none. In one case there is no note regarding this point. The presence or absence of clubbing did not necessarily bear any relationship to the duration of the illness as the child ill for twelve years presented no clubbing of the fingers. The average duration of the condition in those with clubbing was three years and four months, and in those without clubbing three years and five months. But the extent of the pulmonary lesion would seem to have some influence in the production of the clubbing. The mischief was extensive, e.g., involving the whole of one lung or the whole of the lower lobe of each lung in ten of the eleven cases which showed clubbing, whereas in the eleven cases without clubbing the mischief could only be described as extensive in four, being limited to one lobe or portion of a lobe in seven cases.

COUGH AND SPUTUM.

Cough, or a history of cough was present in all cases but one, the girl admitted with symptoms of meningitis in whom post-mortem examination revealed bronchiectasis in both lungs and multiple brain abscesses. The cough varied much, sometimes being very severe. It tended to occur in spasms which might last for an hour at a time. Movement or exertion would often induce a spasm. Sometimes the cough was most troublesome during the night, at other times in the morning on waking.

The cough was accompanied by expectoration in the majority of cases. In one case there was no history of sputum but on "posturing" a small amount was obtained. In four cases no sputum was obtained even on "posturing." In these latter cases the duration of the illness had been one year and five months, six months, six months, and three months; thus in all cases of more than eighteen months' duration sputum was present. In all cases when present the expectoration consisted of more or less liquid greenish pus. As a rule the expectoration was odourless; in only three cases could it be said to be definitely foetid, and in these the condition had been in existence for three, three and a half and four years. In five cases hæmoptysis had occurred and, as seen from Case 1 recorded in detail above, death resulted from a severe hæmoptysis probably due to the rupture of an aneurysm in one of the bronchiectatic cavities. It is not infrequent, however, on "posturing" so as to empty the bronchiectatic cavities to see the last of the sputum expelled slightly tinged or streaked with blood, and we learned to appreciate this as a sign that for the time being no more sputum could be expelled. The amount of sputum brought up at one time and during the twenty-four hours varied much. In some cases as much as two and a half oz. was expectorated at one time whereas in other cases it was with the greatest difficulty that even one drachm would be obtained. During the twenty-four hours we have seen as much as eight ozs. expectorated by one child, whereas in another the daily expectoration would only amount to one drachm. The daily amount of sputum expectorated did not seem to bear any relationship to the extent of the mischief.

PHYSICAL SIGNS.

The physical signs in the chest varied much in this series. In some cases there was shrinking of the whole of one side of the chest with pulling over of the heart so that the apex beat was situated in the axillary line, raising of the diaphragm and dense dullness to percussion all over the affected side. If the accompanying pulmonary fibrosis were limited to one lobe, the shrinking of the side and dullness to percussion were limited to the apex or base. In some cases where the fibrosis and accompanying bronchiectasis were limited in extent and deeply situated there was no appreciable change in the shape of the chest and no dullness to percussion.

Auscultation of the affected side of the thorax often revealed only a defective R.M. On the other hand the R.M. in some cases was unduly loud and tubu-

lar in character and in others amphoric or cavernous. If the bronchiectatic cavities were filled with secretion nothing pointing to cavity formation might be audible: the amphoric character of the R.M., however, sometimes became intense after evacuation of the secretion by getting the patient to cough while inverted, and in any doubtful or suspected case this procedure should never be omitted. When the amphoric character of the R.M. was intense it was as a rule limited to one area, most frequently the neighbourhood of the angle of the scapula, but on occasions this change in the R.M. has been heard at the apex and in the axilla. It has been remarkable that the signs of cavity would be audible only at one base though lipiodol injection or post-mortem examination

Fig. 6.—Case 9. Honeycomb appearance in chronic pneumonia suggesting cavity formation.

revealed the mischief at both bases or widespread throughout the whole of one lung. (See Cases No. 4 and 14 in Appendix.) Not infrequently the whispered voice was well conducted to the area where the amphoric R.M. was audible, but this phenomenon was not so frequent as the hollow character of the R.M.

RADIOLOGICAL EXAMINATION.

X-ray examination of the chest, like physical examination, revealed most diverse pictures, varying between a dense shadow all over one side of the chest to a slight and questionably abnormal reticulated shadow at one base. The varying picture obtained would seem to depend on the extent of the fibrosis of the lung. Sometimes the shadow has the appearance of a honeycomb suggesting cavity formation (See Fig. 6) or dilatation of the bronchi, but

experience with lipiodol injections shows that this conclusion cannot always be drawn from such an appearance. At times the abnormal shadow at the base of one lung has looked like ghosts of dilated bronchi and the lipiodol injection has verified this assumption (*See Figs. 7 & 8*). In the presence of extensive fibrosis a characteristic feature is the displacement of the trachea and the heart to the affected side. (*See Fig. 9*). We are convinced, however, that if one were to depend entirely on the simple X-ray photograph mistakes would frequently be made—bronchiectasis would be diagnosed when it did not exist and its presence missed because of the absence of an unequivocal picture.

Fig. 7.—Case 14. Honeycomb appearance at right base and ghosts of dilated bronchi at left base.

Hence, if one wishes to be certain of the presence of this condition recourse must be had to an X-ray examination of the chest after the instillation of lipiodol into the bronchial tree. By this means, as is evident from the cases detailed above and the various X-ray pictures, the conformation of the bronchi is clearly shown so that it is apparent whether the various branches taper gradually towards their terminations or whether the bronchi are dilated either in their length (tubular bronchiectasis *Figs. 1, 9 and 10*) or merely towards their extremities (saccular bronchiectasis *Figs. 2, 8 and 9*). As previously mentioned the exact distribution of the dilatation is only to be appreciated in this way.

In following the different types of cases injected we have been struck with the varying behaviour of the lipiodol. Not only the distribution of the oil but the rate of its disappearance depended on whether dilatation of the bronchi existed or not. In the presence of bronchiectasis the lipiodol was usually, so far as that portion of the lung was concerned, entirely limited to the lumina of the bronchi and was present as dense and large oblong or circular shadows, whereas in the healthy portion of the lung, it was usually more widespread and present as a fine powdering as if it had gained entrance to the pulmonary alveoli. (Fig. 4.) In fact, this varying picture was so characteristic that

Fig. 8.—Case 14. Sacculated bronchiectasis at both bases.

we learned to utilise it as evidence for or against bronchiectasis. It was also striking how the rate of disappearance of lipiodol from the lung varied. The lipiodol disappeared much more quickly from the bronchiectatic portion of the lung than from the normal portion. In the former all evidence of lipiodol would be gone within 7 to 10 days whereas the fine powdering effect of the oil apparently in the alveoli would persist for as long as three to eight weeks.

LOCALISATION OF THE DISEASE.

One of the most striking features of this disease is its distribution, a fact already referred to and one of great value in the differential diagnosis between bronchiectasis and pulmonary tuberculosis. Bronchiectasis shows a great tendency to be limited to one lung or even one lobe of a lung, to involve the

base of the lung rather than the apex, and to attack the left lung much more frequently than the right, all of which points are in marked contrast to the behaviour of tuberculosis. In fourteen cases the left lung alone was the seat of the disease, in four cases the right lung alone and in five cases both lungs. In none of our cases was the apex of the lung alone involved and in every instance in which the apex was attacked the whole lung was implicated.

This distribution is exactly what has been found by previous writers on chronic pneumonia, which, as we have previously said, for all practical purposes means bronchiectasis. Clark, Hadley and Chaplin (^{1a}) found in their series

Fig. 9.—Case 22. Extreme degree of tubular and saccular bronchiectasis in pneumonia of left lung.

of forty-five cases the left lung involved in twenty-five, the right in fifteen and both in five. Fox(⁷) found the left lung the seat of the disease in twenty-two cases and the right lung in ten, and McNeil(⁸) in his series of five cases observed the left lung diseased in four and the right lung in one. Fox quotes the apex of one lung affected in three cases and both apices in three, but in two of these the affection was tuberculous.

TECHNIQUE OF INJECTION OF LIPIODOL.

In view of the different methods of introducing lipiodol into the bronchial tree some remarks may be permitted regarding our experience with the various techniques. The iodized oil can be introduced into the trachea either by means

of a tube through the glottis (laryngeal syringe or bronchoscope) or by means of a needle inserted through the crico-thyroid membrane. In the case of an adult it may be comparatively simple to use a laryngeal tube. In the child, on the other hand, the glottis is small and we have found it exceedingly difficult to get the pharynx and larynx sufficiently anaesthetised to permit of the operation, and any results obtained in this way have been unsatisfactory. We have seen some quite good results obtained thus in the adult but even in them the pictures were never so good as those obtained by crico-thyroid puncture. In any case it seems to us that in the young child a general anaesthetic is

Fig. 10.—Case 19. Tubular bronchiectasis in left lower lobe.

essential for psychic reasons apart altogether from the physical discomfort of the operation. In older children we have found it possible to perform the operation of crico-thyroid puncture under a local anaesthetic, but the parts in a child are very soft and it is difficult to get the child to avoid any movement or act of swallowing so that the seat of the operation may be kept at rest. With the child under a general anaesthetic, however, it is comparatively simple to enter the trachea through the crico-thyroid membrane. The needle which we have found most suitable is one with a diameter of 1.5 mm., curved and mounted with a flange like a tracheotomy tube and provided with a stilette. The stilette may project beyond the needle when it has a blunt end just as in the

case of an ordinary canula and trochar but the form employed in needles for lumbar puncture is better : here the needle is sharpened to an angle of 45° and the stilette similarly angled to become flush with the needle point. Before giving the anæsthetic it is a wise precaution to empty the bronchiectatic cavities as completely as possible by inverting the child and inducing him to cough. When the child has been completely anæsthetised the thyroid cartilage is grasped between the finger and thumb of the left hand, the crico-thyroid membrane identified, and the needle with stilette *in situ* inserted in a backward and downward direction. If a large needle is employed one learns immediately on the withdrawal of the stilette if it is in the trachea from the rush of air in and out of the tube just as occurs after the insertion of a tracheotomy tube, but with the size of needle recommended the lumen becomes so easily blocked with the purulent secretion in the trachea that no air can pass. We have found, however, that this point can be easily settled by attaching a syringe to the needle and applying suction : if the needle is in the lumen of the trachea air can be readily withdrawn and also introduced. After deciding that the needle is properly in the lumen of the trachea one or two ccm. of a 4% solution of novocaine are injected to counteract any tendency to cough and then the syringe filled with the lipiodol (15 to 30 cc.) is attached and the oil slowly injected. The larger the amount of oil employed the better are the various branches of the bronchial tree demonstrated—in infants of 1 year we have injected as much as 25 ccm. The entrance of the oil into the bronchial tree is aided by elevating the shoulders slightly while the oil is being injected but it is not necessary to turn the child on his side to facilitate the flow into one or other lung. In our experience the bronchiectatic portion of the pulmonary system possesses an affinity for the oil, due probably to the diminished expiratory efforts and resistance in these bronchi. The lipiodol is a very viscid fluid and unless it is warmed will not run through the size of needle recommended, especially when it is bent in the shape of a tracheotomy tube. In consequence a metal syringe which can be easily heated is recommended, and preferably one provided with a piston rod which is worked by a screw so that great pressure may be exerted. Immediately after the injection an X-ray examination of the chest is made, and for this reason it is advantageous when possible to carry out the whole operation in the X-ray department, and in the case of children an instantaneous apparatus is essential for the production of sharp pictures. As a rule some of the lipiodol will have been coughed up and swallowed and will be seen in the stomach, but sufficient will have remained in the bronchial system to demonstrate any abnormality in the calibre of its various components.

COURSE OF THE DISEASE.

Various are the opinions held regarding the course of the disease. Many authorities are non-committal on the question, but others again are very definite in the expression of their view. Nobecourt(*), for example, states quite explicitly that recovery not infrequently takes place and explains this result by suggesting that the dilatation of the bronchi ceases to increase after a time, and that as the

lung grows the bronchi ultimately come to have the normal proportions. This hopeful view has been recently re-affirmed by Thursfield and Paterson⁽¹⁰⁾ during a discussion of the question before the Royal Society of Medicine.

In our experience the condition does not show any marked tendency to heal. Cases in which the history is of more than five years' duration have shown on the whole a tendency to get worse. And from the cases which we have seen come to post-mortem examination we have the greatest difficulty in understanding how recovery can take place. The naked-eye appearance of the section of the lung in some of the cases looked like the section of a sponge and suggested rather a cystic kidney or hydatidiform mole. In this matter of prognosis we would again remark on the uncertainty of diagnosis of the mischief by ordinary physical examination, at least in many cases. This seems to us to be at the very root of the whole question. We do not believe that it is possible, unless with the aid of lipiodol, to form either a definite opinion as to its presence or a correct estimate of its extent. Hence to our mind the truth regarding the course of this disease is reserved for the future. We have seen, as Case 6 detailed above shows, a slowly resolving pneumonia which ultimately cleared up simulate closely bronchiectasis. We were fortunate, however, in demonstrating by means of lipiodol that there was no dilatation of the bronchi, but without this advantage the case might have been classed as an example of recovery from bronchiectasis.

That patients with bronchiectasis may live for many years without showing any severe impairment of the general health is undoubted. This we have seen from our limited survey and most writers record examples attaining a ripe age though suffering from a marked degree of the condition. It is striking, however, while reviewing the literature to notice what a large proportion of the patients are children or adolescents and to learn from conversations with physicians whose clientele is recruited more from the adult than the child population that they seldom meet with the disease. Do these facts signify recovery from the condition or early death and a shortening of life? The latter view was that held by Sir Andrew Clark and Wilson Fox. Both these authors were discussing at the time chronic pneumonia, which they admitted and we ourselves have stated practically means bronchiectasis. Of Clark's series of forty-five cases twenty-seven or 60% were under twenty years of age, and he put the average duration of life after developing the disease at 11.8 years. Of Fox's series of thirty-eight patients he found that twenty-two or 58% died under forty years of age, and the duration of the disease in seventeen of these was only eleven years.

The cause of death may be septic broncho-pneumonia, gangrene of the lung, hæmorrhage or cerebral abscess, events which may occur at any time.

It is remarkable in view of the supposed tendency for tuberculosis to occur in the fibrotic lung of pneumoconiosis that chronic pneumonia and bronchiectasis should be accompanied so seldom by tuberculosis. This fact has already been remarked upon by Clark and McNeil and would seem to support Oliver's ^(10a) contention that the pneumoconionic lung is not specially

susceptible to a tuberculous invasion. *A priori* one has difficulty in understanding how dense fibrous avascular tissue should permit of easy infection and McNeil, while discussing this question, refers to the disappearance of lymph channels in the fibrotic areas as raising a barrier to infiltration by the tuberculous process.

Of our own series of twenty-three patients, nine died, two from septic pneumonia, one of which had in addition early tuberculosis, one from hæmoptysis, one from multiple cerebral abscesses, one from tuberculous meningitis and four as a result of operation. One patient died during the operation for pneumectomy, one two days after the same operation from hæmorrhage through slipping of the ligature at the root of the lung, and two some time after the fixation of the lung to the thoracic wall and incision of the cavities for drainage.

ÆTIOLOGY.

Though Laennec⁽²⁾ gives a very good account of the clinical history and pathological picture of bronchiectasis he expresses no opinion regarding the cause. It was left to Andral writing in 1824 to make the first suggestion. Andral⁽³⁾ considered that inflammation of the bronchi and the consequent diminished resistance of the walls makes them yield when submitted to forced inspiration or expiration as during the spasms of coughing. This same view was expressed in 1837 by Stokes⁽¹¹⁾ of Dublin who contributed the first full account of the disease in English. He believed that loss of elasticity, contractility, and ciliary movement, were the important factors in its ætiology, and held that in all cases the starting point was bronchitis. This is a view which has been resuscitated at different times since and even to-day finds adherents.

Corrigan⁽¹²⁾, one other of that famous group of Dublin physicians, noted for the first time in 1838 another and probably the most important factor in the causation of bronchiectasis. Corrigan considered cirrhosis of the lung analogous to Laennec's cirrhosis of the liver and put forward the view that dilatation of the bronchi was due in part to the contractile processes going on in a cirrhotic lung, and in part to the expansile action of the chest wall. His views are classically stated as follows: "If there were but one bronchial tube with contracting fibro-cellular tissue placed around it, then the contracting tissue would, as in the instance of stricture of the œsophagus or rectum cause narrowing of the tube, but where there is, as in the lung, a number of bronchial tubes and the contracting tissue not placed around the tubes but occupying the intervals between the tubes, then the slow contraction of the tissue will tend to draw the parietes of one tube towards the parietes of another and necessarily dilate them."

Hamilton⁽¹³⁾ many years later in a discussion of Corrigan's theory mentioned the further factors of pleural adhesions and the rigid chest wall, which in his opinion by giving a fixed point of resistance increase the pulling effect on the bronchi. As he says "both the chest wall and the bronchus will be influenced, but the former, being much the stronger of the two and representing an arch

with its concavity towards the point of traction, will be influenced to a less extent than the thin wall of a bronchus with its convexity towards the point of traction." Hamilton, however, considered that increased inspiratory and expiratory efforts with the accumulation of secretions in the bronchi, as suggested by Stokes, might also play a part in those examples following bronchitis, when the weakened bronchial wall in its thinned state would be specially susceptible to increased pulmonary pressure. This view has been embraced by many of the more recent writers, and some of these, e.g., Lebert⁽¹⁴⁾ and Gairdner⁽¹⁵⁾ go so far as to deny fibrosis of the lung as in any way contributory. Grainger Stewart⁽¹⁶⁾ compares the production of bronchiectasis to that of an arterial aneurysm or staphyloma of the eye. Some authors again have introduced a nervous element into the question. Loss of nerve control is the term used by Lebert and Biermer⁽¹⁷⁾.

From a study of our own material we incline to the view that pulmonary fibrosis and pleural adhesions take the chief share, if not the sole burden, in the causation of bronchiectasis. It must be recalled that post-mortem examination of examples of broncho-pneumonia of some weeks' duration not infrequently reveals quite definite, though moderate, bronchiectasis in the pneumonic areas, histological examination of which may show an overgrowth of connective tissue. Of this we have seen many examples, which have left us with the impression that, if these children had been able to withstand the more acute phase of the mischief, fibrosis with clinical bronchiectasis would have resulted.

It is difficult to differentiate between the relative importance of fibrosis and pleural adhesions, because though the history more often suggests broncho-pneumonia as the primary lesion, both are frequently, and in fact in our post-mortem material both invariably were, co-existent. The fact, however, that the disease usually sets in at a period of life when simple pleurisy is so rare, rather militates against the hypothesis that pleurisy *per se* is a common ætiological factor.

It is interesting to note that in a large proportion of the cases the ætiological broncho-pneumonia was secondary to measles and whooping cough, but we can corroborate the statements of Clark and Fox that both primary broncho-pneumonia and lobar pneumonia may be responsible for its production. In the case of pleurisy (Case 7) there was, however, a superimposed fibrosis of the lung.

We agree with Rapp in his scepticism that bronchitis, at least *per se*, can be an ætiological factor. Surely if uncomplicated bronchitis played any prominent part in causing the condition bronchiectasis would be a much more common finding than it is. The fact, too, that the dilatation is most frequently limited to one lung and to only one part of one lung, is surely against the hypothesis that it can be due to a condition which is usually generalised. Nevertheless, not only in our own series but also in those of other writers, a history is sometimes obtained that bronchitis was the starting point of the patient's malady. In our own series this was so in one case, but this patient

was an infant at the time when the difficulty of differentiating between bronchitis and broncho-pneumonia is well-known.

No more does the hypothesis of increased intra-pulmonary pressure appeal to us as in any way responsible for dilatation of the bronchi. From what we have seen of bronchiectatic lungs post-mortem they would seem, on account of the fibrosis, to be in a state to withstand pressure better than in health. Further as the diseased lung can neither expand nor contract so efficiently as in health even if there were a stricture, as some have suggested, the *vis a tergo* (expiratory effort) would be distinctly below normal. Many writers who support this hypothesis remark on the association of the condition with severe coughing but as we have shown in our remarks on the symptomatology coughing may be entirely absent. It is more probable that the cough is dependent on the bronchiectasis rather than that the bronchiectasis is dependent on the cough.

To our mind the only feasible explanation of the condition is the fibrosis of the lung, as first suggested by Corrigan, with the added influence of pleural adhesions, as first pointed out by Hamilton, since without doubt by providing a fixed point for the contracting fibrous tissue these adhesions increase the traction force of the intra-pulmonary fibrosis.

The radiograms were all taken by Dr. D. Campbell Suttie, Superintendent, Royal Hospital for Sick Children, Glasgow, to whom we have much pleasure in expressing our thanks.

APPENDIX.

Synopses of cases of bronchiectasis analysed in this paper.

- No. 1. S.E. (Case 1, p. 73).
- No. 2. I.N. (Case 2, p. 74).
- No. 3. A. McM. (Case 3, p. 75).
- No. 4. R.R. (Case 4, p. 76).
- No. 5. A.T. (Case 5, p. 77).
- No. 6. I.H. (Case 6, p. 78).
- No. 7. C.H., girl, aged 5 years, took ill at three and a half years with broncho-pneumonia and pleurisy. She had a cough with a fœtid muco-purulent expectoration. She weighed 14.1 kilos. and had definite clubbing of the fingers. Physical signs were those of fibrosis of the whole left lung and cavity at the base. Von Pirquet was negative. Operation and death two days later through slipping of the ligature at the root of the lung and severe hæmorrhage. P.M. :—Whole left lung fibrosed with generalised bronchiectasis.
- No. 8. A.D., girl, aged six years and one month : at three years without apparent cause commenced to cough and spit up muco-purulent material. Cough and spit gradually increased and spit became fœtid : ultimately half a teacupful would be brought up at one time, the last portion expectorated being blood-tinged. Fingers had been noticed to be clubbed for two years. Signs of fibrosis of left lung. After posturing R.M. which had been diminished became amphoric at angle of left scapula. Child died under chloroform given for proposed pneumectomy. P.M. :—Left lung sclerosed throughout with great dilatation of bronchi. Right lung healthy.

- No. 9. C.C., boy, aged four years and ten months. Had measles and whooping cough at one year and cough and purulent spit since then. The cough and spit are worse in the evening. There was no fever and the von Pirquet was negative. Height 97 cms.; weight 13.1 kilos. Expansion of left lung impaired, note dull all over left side back and front and in lateral region. R.M. deficient in axilla where it was tubular. On posturing three drachms purulent sputum obtained and R.M. highly tubular in axilla and lateral region. Fingers clubbed. X-ray of chest showed honeycombed shadow all over left side with heart drawn to left (Fig. 6). Lipiodol injection revealed bronchiectasis at left base.
- No. 10. A.P., boy, aged ten years. Had influenza at six years and since then cough cyanosis, and dyspnoea. Admitted to hospital acutely ill with fever, intense cyanosis and dyspnoea. Fingers and toes clubbed. Breath foul. Percussion note dull at both bases. R.M. tubular at right scapular region. X-ray examination of chest showed generalised shadows extending out from both roots. P.M.:—Generalized bronchiectasis both lungs with gangrene of small area in left lower lobe.
- No. 11. J.F., girl, aged four and a half years. Had whooping cough complicated by broncho-pneumonia at three years and had never been well since, cough with profuse purulent expectoration coming on in paroxysms in morning on waking. Had been seen three months after onset of illness when physical and radiological signs were those of fibrosis of whole of left lung. At four and a half years moderately healthy looking child. Height 100 cms. Weight 14.4 kilos. Finger tips clubbed and cyanosed. Left chest shrunken; heart drawn over to left side; dullness to percussion all over left side with tubular R.M. at apex and amphoric R.M. at angle of scapula. Child expectorated about 3 ozs. of sputum daily. Von Pirquet positive. Sputum negative for tubercle bacilli. X-ray of chest showed shadow all over left side with cavitation at apex. Lipiodol revealed bronchiectasis but limited to left lower lobe.
- No. 12. T.M., a boy, aged nine years, came under observation on May 14th, 1925. Had whooping cough at the age of two and a half years and ever since a cough with a profuse yellow spit. Five months previously he had developed a right-sided lobar pneumonia followed by empyema which was drained and healed satisfactorily, but as the cough persisted and in fact was becoming worse, and the purulent expectoration was more profuse, he was referred to the medical side for an opinion. On first coming under our observation he was a healthy looking boy but much under height and weight, measuring 105 cms. and weighing 24 kilos. He had a good colour and there was no clubbing of the fingers. The von Pirquet tuberculin reaction was negative. Examination of the chest revealed an impaired note at the left base with a tubular R.M. at the angle of the scapula. The right chest was clear. After inversion and coughing up half an ounce of muco-purulent expectoration devoid of all odour the percussion note at the left base became clearer, the R.M. definitely amphoric in character, and whispered pectoriloquy could be appreciated. An X-ray photograph of the chest showed a slight shadow at the left base and after the injection of lipiodol extensive dilatation of the bronchi in the left lower lobe. This boy was in residence in hospital for eight weeks during which time his condition remained stationary, the daily amount of sputum varying between one and two ounces. The temperature was normal during the whole residence.
- No. 13. R.S., boy, aged eight years. Developed cough and spit at age of four years—gradually increasing in severity so that one half teacupful would be expectorated at one time. At seven years developed whooping cough and since then symptoms worse and spit frequently streaked with blood. Dull to percussion at left base with tubular R.M. and bubbling râles. After posturing one ounce of fluid muco-purulent material streaked with blood expectorated when dullness at base disappeared and R.M. became amphoric in character. Operation for incision and drainage of cavities. Died three months later.
- No. 14. W.M., a boy, aged seven years. Had broncho-pneumonia at age of two years when he was ill for four months, since then cough and spit with recurrent attacks of fever. Spare

delicate looking boy. Height 124 cms. Weight 17.5 kilos. Slight clubbing of the fingers. Dullness to percussion in right interscapular region with tubular R.M. at angle of scapula and whispered pectoriloquy. Moist râles at both bases. X-ray showed increased hilum shadows in both lungs and honey-comb appearance at both bases. (Fig. 7). Lipiodol revealed extensive saccular bronchiectasis at both bases. (Fig. 8).

- No. 15. J.C., boy, aged six years. Developed whooping cough at one year and had cough and spit ever since. Contracted measles at three years and since then cough and spit worse. Spit latterly frequently streaked with blood and at times definite hæmoptysis. Seen at age of four years when he was noted to be undersized (height 89 cms. and weight 11.9 kilos); there was no cyanosis and no clubbing of the fingers; von Pirquet tuberculin reaction positive. Chest pigeon-shaped with dullness at right base behind and in right lateral region and abundant moist râles at both bases. X-ray revealed shadows at both bases and appearance suggestive of cavity at right base. On second occasion, i.e., when six years of age, was still troubled with cough and greenish spit, especially annoying at night or after violent exercise; he measured 102 cms. and weighed 15.4 kilos.; there was dullness to percussion at left side back and front; X-ray examination revealed slight honeycomb shadows at both bases with suggestion of cavity at right base. Lipiodol revealed extensive tubular dilatation of bronchi apparently in left lower lobe. Otherwise conformation of bronchi was normal.
- No. 16. M.B., girl, aged eight years. Since pneumonia one year previously child had never been well being troubled with cough and breathlessness on exertion. Admitted to hospital acutely ill with fever, rapid respirations and cyanosis of six days duration. She was a much undersized child weighing 13.8 kilos., markedly cyanosed and presenting definite clubbing of fingers. Cough was very troublesome and was accompanied by profuse purulent expectoration which on examination did not reveal any tubercle bacilli. Right side of chest, back and front, was dull to percussion with a diminished and intensely tubular R.M. over scapular region. Abundant râles all over left side. Child continued very ill and died six days after admission. At P.M. examination right lung was found generally adherent, sclerosed and the seat of diffuse cylindrical bronchiectasis: the left lung was enlarged and emphysematous with scattered throughout areas of suppuration. Mediastinal glands enlarged with central areas of suppuration. Microscopic examination of foci in left lung revealed giant cells and caseation.
- No. 17. J.F., boy, aged nine years. Had influenza at three years and measles and whooping cough at four years, since when he has been troubled with a cough and subject to febrile attacks. Came under observation during a febrile attack. Small underweight boy, 108 cms. and 17.2 kilos. Colour good and no clubbing of fingers. Von Pirquet reaction positive. Dull at right base behind below angle of scapula with very deficient R.M. After posturing 1 drachm thick purulent sputum devoid of all odour evacuated and dullness at right base became less intense and R.M. tubular; X-ray revealed widening of mediastinum and shadow at right base and after lipiodol dilatation of bronchi in right lower lobe.
- No. 18. J.B., boy, four years. Took ill six months previously with acute illness characterised by cough, dyspnœa and vomiting. Seen one month later when dullness detected over left chest with much moist clicking râle at base. X-ray of chest revealed shadow throughout left lung with heart pulled over to left. Condition diagnosed as unresolved pneumonia. Seen again five months later with a height of 94 cms. and weight of 13.75 kilos., a troublesome cough, but no history of spit, dull to percussion all over left side of chest, amphoric R.M. in axilla and moist râle all over. X-ray picture showed shadow throughout left side with slight tubular clear areas suggestive of bronchi towards base and honey-comb appearance at apex. After lipiodol saccular dilation of bronchi throughout left lung.
- No. 19. A.S., a girl, aged eight years. Came under observation on account of cough and wasting of eight months' duration. History of broncho-pneumonia at fifteen and twenty-seven months of age, whooping cough at two and a half years with slow recovery, and

broncho-pneumonia again at four and a half years when she was very ill; has never been well since. Eight months previously commenced to complain of pain in left side and a cough which was worst on waking in the morning and was accompanied by a yellow spit. She was an undersized child (109 cms.) and weighed 15.2 kilos. Slightly cyanosed, but no clubbing of the fingers. The von Pirquet reaction was negative. Percussion note impaired all over left side of chest but definitely dull over back with amphoric R.M. and crackling râles at the base. On posturing two drachms odourless purulent expectoration evacuated when R.M. at base became intensely amphoric. X-ray showed shadow at left base with heart pulled to left and after lipiodol dilatation of bronchi in left lower lobe. (Fig. 10).

- No. 20. E. McC., a girl, aged three years, admitted to hospital with cough and purulent spit. Date of onset unknown. She was an undersized child weighing 10 kilos. with cyanosis and clubbing of the fingers. Chest was dull to percussion all over right side back and front with at base behind a definitely amphoric R.M. Sputum examined on several occasions for tubercle bacilli but with negative result. X-ray examination of the chest revealed picture of chronic pneumonia throughout right lung. Child was submitted to operation for incision and drainage of cavities but died two days later. P.M. examination refused.
- No. 21. N.D., a girl, aged twenty months, admitted in a semi-conscious condition, irritable, with slight fever and symptoms of meningitis, which lumbar puncture confirmed and showed to be tuberculous in nature. There was a history that she had had pneumonia three months previously and that there had been a troublesome morning cough since but no spit. Physical examination of the chest revealed dullness in right lateral region but nothing abnormal on auscultation. X-ray examination of the chest showed a shadow at right base with a honey-comb appearance. Child died one week after admission to hospital and at P.M. examination there was found fibrosis of right middle and lower lobes with extensive bronchiectasis: tuberculous meningitis confirmed.
- No. 22. J.R., girl, aged eleven years, had been a healthy child till two years prior to coming under observation. At that time had tonsils and adenoids removed and was immediately afterwards very ill with broncho-pneumonia being confined to bed for four weeks. Since then cough and purulent spit, which have steadily increased in severity. She was a spare and undersized girl; height 132 cms. and weight 26.76 kilos. Colour good but fingers clubbed and cyanosed. Cough troublesome with profuse muco-purulent expectoration devoid of all faecal. Left side of chest retracted, dull to percussion all over back and front with heart drawn over, apex beat being in fifth space four and a half ins. to left of middle line. R.M. tubular all over left side and amphoric at base behind. Whispered voice well heard all over left side. X-ray examination of chest revealed dense shadow all over left side with heart and trachea displaced to left. After lipiodol injection through the crico-thyroid membrane under a local anaesthetic very extensive bronchiectasis (tubular and saccular) throughout left lung was apparent. (Fig. 9.)
- No. 23. P.R., girl, first came under observation on October 18th, 1922, at age of seven years and ten months with history of cough since before she was one year old. At three years she had broncho-pneumonia and cough has been worse since, coming in bouts and lasting for as long as an hour at a time. No history of sputum. Had pneumonia again eight months ago and, according to the doctor who attended her, the left lung did not clear up. On admission to hospital at this time she was an undersized child measuring 102 cms. and weighing 12.14 kilos. The left chest was found smaller than the right with dullness to percussion at left apex and over left lower lobe behind where R.M. was defective but tubular. An X-ray examination of the chest revealed dense shadow all over left side of chest with a somewhat honey-comb appearance at apex and heart and trachea drawn over to the left. She was seen again on June 4th, 1925, when aged eleven and a half. During the interval the cough had persisted and there was still no history of sputum but on posturing two drachms of a thick muco-purulent odourless expectoration was obtained. She weighed 19.11 kilos.

and measured 111.5 cms. There was still dullness all over the left side with R.M. amphoric in the lateral region. X-ray examination on this occasion still showed dense shadow all over left side with cavitation at apex and heart and trachea drawn over to the left. Injection of lipiodol demonstrated definite bronchiectasis in left lower lobe.

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