sacculated bronchus. On the opposite side the percussion note is usually hyperresonant. On *auscultation* the breath-sounds have either a cavernous or amphoric quality at the apex, and at the base are feeble, with mucous, bubbling râles. The voice-sounds are usually exaggerated. Cardiac murmurs are not uncommon, particularly late in the disease, when the right heart fails. These are, of course, the physical signs of the disease when it is well established. They naturally vary considerably, according to the stage of the process. The disease is essentially chronic, and may persist for fifteen or twenty years. Death occurs sometimes from hæmorrhage, more commonly from gradual failure of the right heart with dropsy, and occasionally from amyloid degeneration of the organs.

The *diagnosis* is never difficult. It may be impossible to say, without a clear history, whether the origin is pleuritic or pneumonic. Between cases of this kind and fibroid phthisis it is not always easy to discriminate, as the conditions may be almost identical. When tuberculosis is present, however, even in long-standing cases, bacilli are usually present in the sputa, and there may be signs of disease in the other lung.

Treatment.—It is only for an intercurrent affection or for an aggravation of the cough that the patient seeks relief. Nothing can be done for the condition itself. When possible the patient should live in a mild climate, and should avoid exposure to cold and damp. A distressing feature in some cases is the putrefaction of the contents of the dilated tubes, for which the same measures may be used as in fetid bronchitis.

IV. BRONCHO-PNEUMONIA (*Capillary Bronchitis*).

This is essentially an inflammation of the terminal bronchus and the air-vesicles which make up a pulmonary lobule, whence the term broncho-pneumonia. It is also known as lobular, in contradistinction to lobar pneumonia. The term catarrhal is less applicable. The process begins in all cases with an inflammation of the capillary bronchi, which is a condition rarely if ever found without involvement of the lobular structures, so that it is now customary to consider the affections together.

Etiology.—Broncho-pneumonia is as a rule a secondary affection met with under the following circumstances:

1. As a sequence of the infectious fevers—measles, diphtheria, whooping-cough, scarlet fever, and, less frequently, small-pox, erysipelas, and typhoid fever. In children it forms the most serious complication of these diseases, and in reality causes more deaths than are due directly to the fevers.* In large cities it ranks next in fatality to infantile diarrhœa. Following, as it does, the contagious diseases which principally affect children, we find that a large majority of cases occur during early life.

* Cyclopædia of the Diseases of Children, vol. ii.

According to Morrill's Boston statistics, it is most fatal during the first two years of life. The number of cases in a community increases or decreases with the prevalence of measles, scarlet fever, and diphtheria. It is most prevalent in the winter and spring months. In the febrile affections of adults broncho-pneumonia is not very common. Thus in typhoid fever it is not so frequent as lobar pneumonia, though isolated areas of consolidation at the bases are by no means rare in protracted cases of this disease. In old people it is an extremely common affection, following debilitating causes of any sort, and supervening in the course of chronic Bright's disease and various acute and chronic maladies.

2. In the second division of this affection are embraced the cases of so-called aspiration or deglutition pneumonia. Whenever the sensitiveness of the larynx is benumbed, as in the coma of apoplexy or uræmia, minute particles of food or drink are allowed to pass the *rima*, and, reaching finally the smaller tubes, excite an intense inflammation similar to the vagus pneumonia which follows the section of the pneumogastrics in the dog. Cases are very common after operations about the mouth and nose, after tracheotomy, and in cancer of the larynx and œsophagus. The aspirated particles in some instances induce such an intense broncho-pneumonia that suppuration or even gangrene supervenes.

3. The most common and fatal form of broncho-pneumonia is that excited by the tubercle bacillus, which has already been considered.

Among general predisposing causes may be mentioned age. As just noted, it is prone to attack infants, and a majority of cases of pneumonia in children under five years of age are of this form. At the opposite extreme of life it is also common, particularly in association with various debilitating circumstances and chronic diseases incident to the old. In children rickets and diarrhœa are marked predisposing causes, and broncho-pneumonia is one of the most frequent post-mortem-room lesions in infants' homes and foundling asylums. The disease prevails more extensively among the poorer classes, because their children are of necessity more exposed and cannot have the needful care and nursing, particularly after eruptive fevers.

Morbid Anatomy.—In the lungs of a child dead of broncho-pneumonia, after measles or diphtheria, the appearances are very characteristic. On the pleural surfaces, particularly toward the base, are seen depressed bluish or blue-brown areas of collapse, between which the lung tissue is of a lighter color. Here and there are projecting portions over which the pleura may be slightly turbid or granular. The lung is fuller and firmer than normal, and, though in great part crepitant, there can be felt in places throughout the substance solid, nodular bodies. The dark depressed areas may be isolated or a large section of one lobe may be in the condition of collapse or atelectasis. Gradual inflation by a blow-pipe inserted in the bronchus will distend a great majority of these collapsed areas. On section, the general surface has a dark reddish color and usu-

ally drips blood. Projecting above the level of the section are lighter red or reddish-gray areas representing the patches of broncho-pneumonia. These may be isolated and separated from each other by tracts of uninflamed tissue or they may be in groups or the greater part of a lobe may be involved. Study of a favorable section of an isolated patch shows: (*a*) A dilated central bronchiole full of tenacious purulent mucus. A fortunate section parallel to the long axis may show a racemose arrangement—the alveolar passages full of muco-pus. (*b*) Surrounding the bronchus for from 3 to 5 mm. or even more is an area of grayish-red consolidation, usually elevated above the surface and firm to the touch. Unlike the consolidation of lobar pneumonia, it may present a perfectly smooth surface, though in some instances it is distinctly granular. In a late stage of the disease small grayish-white points may be seen, which on pressure may be squeezed out as purulent droplets. A section in the axis of the lobule may present a somewhat grape-like arrangement, the stalk and stems representing the bronchioles and alveolar passages filled with a yellowish or grayish-white pus, while surrounding them is a reddish-brown hepatized tissue. (*c*) In the immediate neighborhood of this peribronchial inflammation the tissue is dark in color, smooth, airless, at a somewhat lower level than the hepatized portion, and differs distinctly in color and appearance from the other portions of the lung. This is the condition to which the term *splenization* has been given. It really represents a tissue in the early stage of inflammation, and it perhaps would be as well to give up the use of this term and also that of *carnification*, which is only a more advanced stage. The condition of collapse probably always precedes this, and it is difficult in some instances to tell the difference, as one shades into the other. In fact, collapse, splenization, and carnification may be said in broncho-pneumonia to be steps preliminary to the condition of actual hepatization.

While, in many cases, the areas of broncho-pneumonia present a reddish-brown color and are indistinctly granular, in others, particularly in adults, the nodules may resemble more closely gray hepatization and the air-cells are filled with a grayish, muco-purulent material. Minute hæmorrhages are sometimes seen in the neighborhood of the inflamed areas or on the pleural surfaces. Emphysema is commonly seen at the anterior borders and upper portions of the lung or in lobules adjacent to the inflamed ones. In many cases following diphtheria and measles the process is so extensive that the greater part of a lobe is involved, and it looks like a case of lobar hepatization. It has not, however, the uniformity of this affection and collapsed dark strands may be seen between extensive areas of hepatized tissue.

Practically, in the morbid anatomy of broncho-pneumonia in children we may recognize three groups of cases: (1) Those in which the bronchitis and bronchiolitis are most marked and in which there may be no definite consolidation and yet on microscopical examination many of the

alveolar passages and adjacent air-cells appear filled with inflammatory products. (2) The disseminated broncho-pneumonia, in which there are scattered areas of peribronchial hepatization with patches of collapse, while a considerable proportion of the lobe is still crepitant. This is by far the most common condition. (3) Pseudo-lobar form, in which the greater portion of the lobe is consolidated, but not uniformly, for intervening strands of dark congested lung tissue separate the groups of hepatized lobules.

In the secondary broncho-pneumonia of adults, it is generally the disseminated form which is seen.

Microscopically, a cross section of a small broncho-pneumonic focus shows the following changes: In the centre is a bronchus filled with a plug of exudation, consisting of leucocytes and swollen epithelium. Section in the long axis may show irregular dilatations of the tube. The bronchial wall is swollen and infiltrated with cells. Under a low power it is readily seen that the air-cells next the bronchus are most densely filled, while toward the periphery of the focus the alveolar exudation becomes less. The contents of the air-cells are made up of leucocytes and swollen endothelial cells in varying proportion. Red corpuscles are not often present and a fibrin network is rarely seen, though it may be present in some alveoli. In the swollen walls are seen distended capillaries and numerous leucocytes. As Delafield has pointed out, the interstitial inflammation of the bronchi and alveolar walls is a special feature of broncho-pneumonia which distinguishes it from the ordinary croupous form.

The histological changes in the aspiration or deglutition broncho-pneumonia differ from the ordinary post-febrile form in a more intense infiltration of the air-cells with leucocytes, producing suppuration and foci of softening, and even tending to gangrene.

Broncho-pneumonia may terminate (1) in *resolution*, which when it once begins goes on more rapidly than in fibrinous pneumonia. Broncho-pneumonia of the apices, in a child, persisting for three or more weeks, particularly if it follows measles or diphtheria, is often tuberculous. In these instances, when resolution is supposed to be delayed, caseation has in reality taken place. (2) In *suppuration*, which is rarely seen apart from the aspiration and deglutition forms, in which it is extremely common. (3) In *gangrene*, which occurs under the same conditions. (4) In *fibroid changes—chronic broncho-pneumonia*—a rare termination in the simple, a common sequence of the tuberculous disease. Formerly it was thought that one of the most common changes in broncho-pneumonia, particularly in children, was caseation; but this is really a tuberculous process, the natural termination of an originally specific broncho-pneumonia. It is of course quite possible that a broncho-pneumonia, simple in its origin, may subsequently be the seat of infection by the *bacillus tuberculosis*.

Symptoms.—Much confusion has arisen from the description of capillary bronchitis as a separate affection, whereas it is only a part, though a primary and important one, of broncho-pneumonia. At the outset it may be said that if in convalescence from measles or in whooping-cough a child has an accession of fever with cough, rapid pulse, and rapid breathing, and if, on auscultation, fine râles are heard at the bases, or widely spread throughout the lungs, even though neither consolidation nor blowing breathing can be detected, the diagnosis of broncho-pneumonia may safely be made. I have never seen in a fatal case after diphtheria or measles a capillary bronchitis as the sole lesion. The onset is rarely sudden, or with a distinct chill; but after a day or so of indisposition the child gets feverish and begins to cough and to get short of breath. The fever is extremely variable; a range of from 102° to 104° is common. The skin is very dry and pungent. The cough is hard, distressing, and may be painful. Dyspnœa gradually becomes a prominent feature. Expiration may be jerky and grunting. The respirations may rise as high as 60 or even 80 in the minute. Within the first forty-eight hours the percussion resonance is not impaired; the note, indeed, may be very full at the anterior borders of the lungs. On auscultation, many râles are heard, chiefly the fine subcrepitant variety, with sibilant rhonchi. There may really be no signs indicating that the parenchyma of the lung is involved, and yet even at this early stage, within forty-eight hours of the onset of the pulmonary symptoms, I have repeatedly, after diphtheria, found scattered nodules of lobular hepatization. Northrup,* in his thorough article on the subject, notes a case in which death occurred within the first twenty-four hours, and, in addition to the extensive involvement of the smaller bronchi, the intralobular tissue also was involved in places. The dyspnœa is constant and progressive and soon signs of deficient aëration of the blood are noted. The face becomes a little suffused and the finger-tips bluish. The child has an anxious expression and gradually enters upon the most distressing stage of asphyxia. At first the urgency of the symptoms is marked, but soon the benumbing influence of the carbon dioxide on the nerve-centres is seen and the child no longer makes strenuous efforts to breathe. The cough subsides and, with a gradual increase in lividity and a drowsy restlessness, the right ventricle becomes more and more distended, the bronchial râles become more liquid as the tubes fill with mucus, and death occurs from heart paralysis. These are the symptoms of a severe case of broncho-pneumonia, or what the older writers called *suffocative catarrh*.

The *physical signs* may at first be those of capillary bronchitis, as indicated by the absence of dulness, the presence of fine subcrepitant and whistling râles. In many cases death takes place before any definite pneumonic signs are detected. When these exist they are much more frequent

* Reference Handbook of the Medical Sciences, art. Broncho-Pneumonia.

at the bases, where there may be areas of impaired resonance or even of positive dulness. When numerous foci involve the greater part of a lobe the breathing may become tubular, but in the scattered patches of ordinary broncho-pneumonia, following the fevers, the breathing is more commonly harsh than blowing. In grave cases there is retraction of the base of the sternum and of the lower costal cartilages during inspiration, pointing to deficient lung expansion.

Diagnosis.—With lobar pneumonia it may readily be confounded if the areas of consolidation are large and merged together. It is to be remembered that broncho-pneumonia occurs chiefly in children under five years of age, whereas lobar pneumonia in children is much more common between the ages of five and fifteen. No writer has so clearly brought out the difference between pneumonia at these periods as Gerhard,* of Philadelphia, whose papers on this subject, though published nearly sixty years ago, have the freshness and accuracy which characterize all the writings of that eminent physician. Holt has recently brought forward figures to show that lobar pneumonia is not infrequent in infants under two years of age. The mode of onset is essentially different in the two affections, the one developing insidiously in the course or at the conclusion of another disease, the other setting in abruptly in a child in good health. In lobar pneumonia the disease is almost always unilateral, in broncho-pneumonia bilateral. The chief trouble arises in cases of broncho-pneumonia, which by aggregation of the foci involves the greater part of one lobe. Here the difficulty is very great, and the physical signs may be practically identical, but in a broncho-pneumonia it is much more likely that a lesion will be found on the other side. The course of the two affections is very unlike; the lobar pneumonia in children terminates on the eighth or tenth day with abruptness, as in adults.

A still more difficult question to decide is whether an existing broncho-pneumonia is simple or tuberculous. In many instances the decision cannot be made, as the circumstances under which the disease occurs, the mode of onset, and the physical signs may be identical. It has often been my experience that a case has been sent down from the children's ward to the dead-house with the diagnosis of post-febrile broncho-pneumonia in which there was no suspicion of the existence of tuberculosis; but on section there were found tuberculous bronchial glands and scattered areas of broncho-pneumonia, some of which were distinctly caseous, while others showed signs of softening. I have already spoken fully of this in the section on tuberculosis, but it is well to emphasize the fact that there are many cases of broncho-pneumonia in children which time alone enables us to distinguish from tuberculosis. The existence of extensive disease at the apices or central regions is a suggestive indication, and signs of softening may be detected. In the vomited matter, which is brought

* American Journal of the Medical Sciences, vols. xiv and xv.