

cannot be identified as phthisis during life unless we make it an invariable rule to examine for tubercle bacilli the sputa of every case in which sputa can be obtained, *no matter what are the physical signs.*

Phthisis with Anomalous Distribution of the Lesions.

Very rarely a tuberculous process may begin at the base of the lung. When the process seems to begin in this way, a healed focus is often to be found at one apex surrounded by a shell of healthy lung.

The summit of the axilla should always be carefully examined, as tuberculous foci may be so situated as to produce signs only at that point.

Another point often overlooked in physical examination is the *lingula pulmonalis* or tongue-like projection from the anterior margin of the left lung overlapping the heart. Tuberculosis is sometimes found further advanced at this point than anywhere else.

As a rule cases in which signs like those of phthisis are found at the base of the lung turn out to be either empyema, or abscess, or unresolved pneumonia (cirrhosis of the lung).

Acute Pulmonary Tuberculosis.

No one of the three forms in which acute phthisis occurs, viz.,

(a) Acute tuberculous pneumonia,

(b) Acute tuberculous bronchitis and peribronchitis,

(c) Acute miliary tuberculosis, involving the lungs, can be recognized by physical examination of the chest. The first form is almost invariably mistaken for ordinary croupous pneumonia, until the examination of the sputa establishes the correct diagnosis. In the other two forms of the disease, the physical signs are simply those of general bronchitis.

CHAPTER XV.

EMPHYSEMA, ASTHMA, PULMONARY SYPHILIS, ETC.

I. EMPHYSEMA.

FOR clinical purposes, the great majority of cases of emphysema may be divided into two groups.

(1) *Large-lunged* emphysema, usually associated with chronic bronchitis and asthma.

(2) *Small-lunged*, or senile, emphysema.

Although the second of these forms is exceedingly common, it is so much less likely than the first form to give rise to distressing symptoms that it is chiefly the large-lunged emphysema which is seen by the physician. In both conditions we have a dilatation and finally a breaking down of the alveolar walls until the air spaces are become relatively large and inelastic. In both forms, the elasticity of the lung is diminished; but in the large-lunged form we have an increase in the volume of the whole organ in addition to the changes just mentioned.

Large-Lunged Emphysema.

The diagnosis can usually be made by inspection alone. In typical cases the antero-posterior diameter of the chest is greatly increased, the in-spaces are widened, and the costal angle is blunted, while the angle of Ludwig¹ becomes prominent. The shoulders are high and stooping and the neck is short (see Fig. 164). The patient is often considerably cyanosed, and his breathing rapid and difficult. Inspiration is short and harsh; expiration prolonged and difficult. The ribs move but little, and, owing to the ossification of their car-

¹ Formed by the junction of the manubrium with the second piece of the sternum.

tilages, are apt to rise and fall as if made in one piece (*en cuirasse*). The working of the auxiliary muscles of respiration is not infrequently seen. The diaphragm shadow (Litten's sign) begins its excursion one or two ribs farther down than usual and moves a much shorter distance than in normal cases.

Palpation shows a diminution in the tactile fremitus, throughout the affected portions; that is, usually throughout the whole of both lungs. Sometimes it is scarcely to be perceived at all.

Percussion yields very interesting information. The disease manifests itself—

(a) By hyper-resonance on percussion, with a shade of tympanitic quality in the note.

(b) By the extension of the margins of the lung so that they encroach upon portions of the chest not ordinarily resonant.

The degree of hyper-resonance depends not only upon the degree of emphysema but upon the thickness of the chest walls. The note is most resonant and has most of the tympanitic quality when the disease occurs in old persons with relatively thin chest walls. The encroachment of the over-voluminous lungs upon the liver and heart is demonstrated by the lowering of the line of liver flatness from its ordinary position at the sixth rib to a point one or two interspaces farther down or even to the costal margin, while the area of cardiac dulness may be altogether obliterated, the lungs completely closing over the surface of the heart. At the apices of the lungs resonance may be obtained one or two centimetres higher than normally and the quality may be markedly tympanitic. In the axillæ and in the back the pulmonary resonance extends down one inch or more below its normal position.

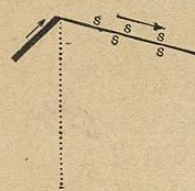


FIG. 164.—Barrel Chest due to Chronic Bronchitis and Emphysema.

Auscultation shows in uncomplicated cases no very marked modification of the inspiratory murmur, which, however, may be shortened and enfeebled. The most striking change is a *great prolongation and enfeeblement of expiration*, with a lowering of its pitch (see Fig. 165).

This type of breathing is like bronchial breathing in one respect; namely, that in both of them expiration is made prolonged, but emphysematous breathing is feeble and low-pitched, while bronchial breathing is intense and high-pitched. At the bases of the lungs the respiration is especially feeble and may be altogether replaced by crackling râles.

FIG. 165.—Diagram to Illustrate Emphysematous Breathing with Musical Expiratory Râles.



In "small-lunged emphysema" we have precisely the same physical signs, except that the boundaries of the lung are not extended, expiration is less prolonged and less difficult, and inspiration is normal. It does not tend to be complicated by bronchitis and asthma; indeed the small-lunged emphysema rarely gives rise to any symptoms, and is discovered as a matter of routine physical examination.

Summary.

1. Hyper-resonance on percussion.
2. Feeble breathing with prolonged expiration.
3. Diminished fremitus and voice sounds.
4. Encroachment of the resonant lungs on the heart and liver dulness (in the large-lunged form).

Differential Diagnosis.

(a) *Emphysema* may be confounded with *pneumothorax*, since in both conditions hyper-resonance and feeble breathing are present. But emphysema is usually bilateral, encroaches upon but does not displace neighboring organs, and is not often associated with hydrothorax. Emphysema, if extensive, is usually associated with chronic bronchitis and so with squeaking or bubbling râles, while in

pneumothorax breathing is absent or distant amphoric without râles.

(b) The signs of *aneurism* of the aorta pressing on the trachea or on a primary bronchus are sometimes overlooked because the foreground of the clinical picture is occupied by the signs of a coexisting bronchitis with emphysema. The cough and wheezing which the presence of the aneurism produces may then be accounted for as part of the long-standing bronchitis, and the dulness and thrill over the upper sternum to which the aneurism naturally gives rise may be masked by extension of lung borders. But the evidence of pressure on mediastinal nerves and vessels (aphonia, unequal pulses or pupils, etc.), and the presence of a diastolic shock and tracheal tug are usually demonstrable; the danger is that we shall forget to look for them.

(c) *Uncompensated mitral stenosis* may produce dyspnoea and cyanosis and weak rapid heart action somewhat similar to that seen in emphysema, and may not be associated with any cardiac murmur, but the dyspnoea is not of the expiratory type, and the irregularity of the heart, with evidence of dropsy and general venous stasis, should make it evident that something more than simple emphysema is present.

(d) The occurrence of an emphysematous form of *phthisis* I have already mentioned in discussing the latter disease (see p. 304).

Emphysema with Bronchitis or Asthma.

In the great majority of cases, emphysema of the lungs is associated with chronic bronchitis and very often with asthmatic paroxysms. Such association is especially frequent in elderly men who have had a winter cough for many years and in whom arterio-sclerosis is more or less well marked. In such cases the prolonged and feeble expiration is usually accompanied by squeaking and groaning sounds, or by moist râles of various sizes and in various parts of the chest. When the asthmatic element predominates, dry râles are more noticeable, and occur chiefly or wholly during expiration, while inspiration is reduced to a short, quick gasp.

Interstitial Emphysema.

In rare cases violent paroxysms of coughing may rupture the walls of the alveoli so as to allow the passage of air into the interstitial tissue of the lung, from whence it may work through and manifest itself under the skin, giving rise to a peculiar crackling sensation on palpation, and to a similar sound on auscultation. More frequently the trouble arises in connection with a tracheotomy wound, the air penetrating under the skin and producing a downy, crepitating swelling.

"Complementary Emphysema."

When extra work is thrown upon one lung by loss of the function of the other, as in pleuritic effusion—a considerable stretching of the overworked sound lung may take place. The elasticity of the lung is not diminished as in emphysema, but is greatly increased. Hence the term complementary emphysema should be dropped and the term complementary (or compensatory) *hyper-resonance* substituted.

Like emphysema, this condition leads to hyper-resonance on percussion and to encroachment of the pulmonary margins upon the neighboring organs (as shown by a reduction in the area of dulness corresponding to them), but the respiratory murmur is *exaggerated* and has none of the characteristics of emphysematous breathing.

A word may here be added regarding the condition described by West under the name of

Acute Pulmonary Tympanites.

In fevers and other acute debilitating conditions West has observed that the lungs may become hyper-resonant and somewhat tympanitic on percussion, owing, he believes, to a loss of pulmonary elasticity. The tympanitic note, often observable around the solidified tissue in pneumonia, is to be accounted for, he believes, in the same way. Like the shortening of the first heart sound, acute pulmonary tympanites points to the weakening of muscle fibre which toxæmia is so apt to produce. Apparently the muscle fibres of the lung suffer like those of the heart.

BRONCHIAL ASTHMA.

(PRIMARY SPASM OF THE BRONCHI).

During a paroxysm of bronchial asthma our attention is attracted even at a distance by the loud, wheezing, prolonged expiration preceded by an abortive gasping inspiration. The breathing is labored, much quickened in rate, and cyanosis is very marked. The chest is distended and hyper-resonant, the position of the diaphragm low and its excursion much limited, and the cardiac and hepatic dulness obliterated by the resonance of the distended lungs. On auscultation, practically no respiratory murmur is to be heard despite the violent plunging of the chest walls. We hear squeaks, groans, muscular rumbles, and a variety of strange sounds, but amid them all practically nothing is to be heard of the *breath sounds*. "The asthmatic storm flits about the chest, now here now there," the râles appearing and disappearing.

At the extreme base of the lungs there may be dulness due to atelectasis of the thin pulmonary margins.

Differential Diagnosis.

(a) Mechanical irritation of the bronchi, as by the pressure of an aneurism or enlarged gland, may set up a spasm of the neighboring bronchioles much resembling that of primary bronchial asthma, but thorough examination should reveal other evidence of mediastinal pressure, and the history of the case is very different from that of asthma.

(b) *Spasm of the glottis* produces a noisy dyspnoea, but the difficulty is with *inspiration*, instead of with expiration, and the crowing or barking sound is not like the long wheeze of asthma. No râles are to be heard, and the signs in the lungs are those of collapse instead of the distention characteristic of asthma.

(c) The paroxysmal attacks of dyspnoea, which often occur in chronic nephritis, myocarditis, and other diseases of the heart and kidney, may be entirely indistinguishable from primary bronchial asthma but for the evidence of the underlying cardiac or renal dis-

ease. As a rule, however, the element of spasm is much less marked; the breathing is quick and labored but not wheezing, expiration is less prolonged, and the squeaking and groaning râles of asthma are not present.

SYPHILIS OF THE LUNG.

The diagnosis cannot be made with certainty from the physical signs, and rests entirely (in the rare cases in which it is made at all) on the history, the evidence of syphilis elsewhere in the body, and the result of treatment. Most cases are mistaken for phthisis.

Any case supposed to be phthisis, but in which the examination of the sputa for tubercle bacilli is repeatedly negative, should be given a course of syphilitic treatment.

The physical signs, as in phthisis, are those of localized bronchitis or of solidification, but the lesions are not at the apex but usually about the root of the lung or lower down. Cavities are not formed. Stenosis of a bronchus may occur with resulting atelectasis of the corresponding lobules.

BRONCHIECTASIS (BRONCHIAL DILATATION).

This rare disease is still more rarely to be recognized during life. It is suggested by the history of raising within a few seconds or minutes a large amount of foul sputa, a pint or more in marked cases. The physical signs may not be in any way distinctive, or may be those of pulmonary cavity due to tuberculosis. From the latter bronchiectasis is to be distinguished in some cases by a knowledge of the previous history. Signs of cavity in phthisis are preceded and surrounded by signs of solidification in the same area, while in bronchiectasis this is not the case. Again, a bronchiectatic cavity is apt to occur, not at the apex, as in phthisis, but in the middle and lower thirds of the lung posteriorly. Aside from the history and situation of the cavity and the presence or absence of solidification around it, we cannot tell from physical signs whether it be due to tuberculosis or to dilatation of a bronchus. In either case we have the signs discussed on page 313 (cracked-pot reso-

nance, amphoric breathing and voice sounds, coarse gurgling or splashing sounds on cough)—all these signs disappearing when the cavity becomes filled with secretions.

The disease may cause marked retraction of the chest on the affected side, and neighboring organs may be drawn out of place.

CIRRHOSIS OF THE LUNG.

(*Chronic Interstitial Pneumonia.*)

As an end stage of unresolved croupous pneumonia, or as a result of chronic irritation from mineral or vegetable dust, a shrinkage of a part or the whole of the lung may occur, which progresses until the pulmonary tissue is transformed into a fibrous mass enclosing bronchi.

The side of the chest corresponding to the affected lung becomes shrunken and concave; fremitus is increased, percussion resonance diminished or lost, respiration tubular with coarse râles.

From tuberculosis the condition is to be distinguished solely by the history, the absence of bacilli in the sputa, and the comparative mildness of the constitutional symptoms.

The right ventricle of the heart may become hypertrophied and later dilated with resulting tricuspid insufficiency.

EXAMINATION OF SPUTA.

I. *Origin.*—Probably the majority of all sputa, excepting tobacco juice, come from the *nasopharynx*, and are *hawked*, not coughed up. It is rarely of value to examine such sputa, although influenza bacilli, diphtheria bacilli, pneumococci, and other bacteria may be found.

What we want in most cases is sputa coughed up from the primary bronchi or lower down, and the patient should be accordingly instructed. Early morning cough is most likely to bring up sputa from the bronchi.

Young children do not raise sputum, but when it is important to obtain it we may insert the forefinger (covered with a bit of cotton) into the pharynx, so as to excite a spasm of coughing. The

sputum is deposited on the cotton before the child has time to swallow it, and may then be withdrawn and examined.

II. *Quantity.*—If the amount expectorated is large (*i.e.*, one-half a pint or more in twenty-four hours), we may be dealing with:

1. Pulmonary oedema (watery, sometimes pink and frothy).
2. Advanced phthisis (muco-purulent).
3. Empyema ruptured into a bronchus (pure pus).
4. Abscess of the lung (foul smelling).
5. Bronchiectasis (large amount within a few minutes on change of position).

III. *Odor.*—Unless retained in a lung cavity (abscess, bronchiectasis), sputum is rarely ill-smelling. In gangrene of the lung the breath as well as the sputum is horribly offensive, and the odor soon fills the room and the house.

IV. *Gross Appearances.*—(*a*) *Bloody sputum* (hæmoptysis) means *pure or nearly pure blood in considerable quantity*, a teaspoonful or more, not mere streaks of blood in muco-purulent sputum, which usually comes from an irritated throat.

Hæmoptysis thus defined is seen chiefly in the following conditions, arranged in the order of frequency:

1. Phthisis.
2. Pulmonary congestion with infarction (mitral disease).
3. Pneumonia.
4. After epistaxis.
5. Abscess or gangrene of the lung.
6. Without known cause ("vicarious menstruation," etc.).

Rare causes are new growths of the lung, parasites (*Distomum Westermanni*), aortic aneurism rupturing into an air tube, ulcer of the trachea or bronchi.

The cause of hæmoptysis can usually be made out by a thorough examination of the chest and a study of the other symptoms in the case. In phthisis there are often no physical signs in the lungs at the period when the bleeding occurs or for some weeks after it. Blood *coughed up* can usually be distinguished from *blood vomited* (*hæmatemesis*) by careful questioning and by examining the blood. Blood coughed up often contains bubbles of air and is alkaline in

reaction, while blood from the stomach is usually mixed with food, not frothy, and perhaps acid in reaction.

(b) *Pneumonic Sputum*.—The color is most characteristic; it is either

- (1) Tawny-yellow or fawn-colored ("rusty"), or
- (2) Orange-juice colored (*not* orange, but pale straw colored).

These colors, associated with *great tenacity*, so that the sputum clings to the lips and does not fall from an inverted sputum-cup, are almost pathognomonic of pneumonia—though pneumonia often occurs without any such sputa.

(c) *Serous sputum*, profuse and watery, is characteristic of pulmonary œdema.

(d) *Black or gray sputum* is due to carbon, dust, or tobacco smoke inhaled.

(e) *Pure pus*—not muco-purulent—is oftenest seen in influenza, occasionally in empyema breaking through the lung.

(f) *Muco-purulent sputum* occurs in many diseases and is characteristic of none.

IV. *Microscopic Examination*.—Ninety-nine-one-hundredths of all examinations are for the tubercle bacillus. Of the many useful methods of staining for this organism the following seems to me the best:

1. Pick out with forceps the most purulent portion of the sputa and smear it *thinly* over a cover glass. All particles thick enough to be opaque should be removed from the cover glass before staining.

2. Dry the preparation *held in the fingers* over a Bunsen or alcohol flame. Then fix it in Cornet's forceps and pass it three times through the flame, sputum side down.

3. Flood it with carbolic fuchsin,¹ and steam it—do *not* boil it—over the flame for about thirty seconds. Be sure to use enough stain so that it does not dry on the cover glass.

4. Wash in water and decolorize for twenty seconds in twenty-per-cent H₂SO₄.

¹ Carbolic-acid crystals, 5 gm.; fuchsin (saturated alcoholic solution), 10 gm.; water, 100 gm.

5. Wash in water and then in ninety-five-per-cent alcohol for thirty seconds or until the color ceases to come out.

6. Wash in water and cover with Löffler's methylene blue¹ for about thirty seconds.

7. Wash in water, dry on blotting paper, and mount in Canada balsam.

The whole process need not take more than five minutes, and it is absolutely essential that every physician should be familiar with it.

The bacilli are stained red, everything else blue. They should be looked for only with an immersion lens (one-twelfth-inch), a wide-open diaphragm, and a good white light. In the vast majority of cases the bacilli are found, if at all, within a few minutes and in almost every field. Occasionally one has to search longer, but it is better to search one well-stained preparation thoroughly than to spend the time in preparing and examining several.

The *presence of red-stained bacilli* in specimens of sputa so prepared is practically pathognomonic of tuberculosis. Other acid-resisting bacilli occur in the urine, but almost never in the lung.

The *absence of tubercle bacilli* after at least six examinations of satisfactory specimens² obtained several days apart makes it very unlikely that phthisis is present. One or two negative examinations are of no significance.

Pneumococcic and Influenza Bacilli.—For both these organisms *Gram's stain* is on the whole the best. This is performed as follows:

1. Prepare a smear as above directed.

2. Cover it with aniline-oil-gentian-violet solution³ (freshly made each week) and heat to steaming point.

¹ Saturated alcoholic solution of methylene blue, 30 c.c.; aqueous solution of KOH (1 in 10,000), 100 c.c.

² A satisfactory specimen is one prepared without any slips in technique from purulent sputa obtained by coughing and not by hawking.

³ Saturated alcoholic solution of gentian violet, 13 c.c.; aniline water, 84 c.c.; aniline water is the *clear filtrate* from the mixture of aniline, 5 parts, with water, 25 parts.

3. Wash in water and cover with IKI solution¹ for thirty seconds.
4. Wash in ninety-five-per-cent alcohol until the blue color ceases to come out.
5. Counterstain with Bismarck brown for thirty seconds.
6. Wash in water and mount in Canada balsam.

The pneumococcus with this stain comes out blue-black and its morphology is well shown (see Fig. 166). The presence of a



FIG. 166.—Pneumococci in Sputum. (W. H. Smith.) (Gram's stain.)

few pneumococci free in the sputum is not of importance. When the organisms are very abundant, and especially when many of them are contained within leucocytes, a pneumococcus infection is strongly suggested, though it may be a pneumococcus bronchitis without pneumonia. In the earliest stages of an infection fewer

¹Iodine, 1 gm.; potassium iodide, 2 gm.; water, 300 c.c.

organisms are found within leucocytes than is the case later. Obviously one can learn only by practice what is meant by "few" or "many" organisms.

The *influenza bacillus* is the smallest organism to be found in the sputum. In specimens stained by Gram's method (as above given) the influenza bacilli come out as minute, faintly brown-stained points, contrasting with the intense blue-black of pneumococci and other organisms. Only when present in large numbers both inside and outside the leucocytes of the sputa are they diagnostic of active influenzal infection, since the organism is a common inhabitant of the upper air passages.

Although other organisms—actinomyces, micrococcus catarrhalis, streptococcus, bacillus mucosus capsulatus—are sometimes found in sputa, their importance does not justify an account of them here.

Indications for Sputum Examination.—Any cough with sputa lasting more than a week calls for an examination of sputa. In doubtful cases of influenza or pneumonia, and in any case in which tuberculosis is suspected, an examination is imperative.

When the symptoms or physical signs suggest tuberculosis but no sputa can be obtained, it is well to stimulate the bronchial secretions with 10 gr. of potassium iodide after meals for a week. A way of getting sputa from young children has already been described (page 324).