

size. Small or moderate right-sided effusions often do not displace the heart at all.

With left-sided effusions, unless very small, we find the area of cardiac dulness shifted toward the right and often projecting beyond the right edge of the sternum (see Fig. 173). (Inspection and palpation often give us even more valuable information on this point. See below, p. 347.) We must be careful to distinguish such an area of dulness at the right sternal margin from that which may be produced in right-sided effusions by the fluid itself (see above).

As mentioned above, a right pleural effusion may very early show itself as an area of dulness along the right sternal margin. Light percussion will usually demonstrate that this dulness is continuous with a narrow strip of flatness at the base of the axilla (ninth and tenth ribs). Such an effusion is late in creeping up the axilla. It appears first and disappears first along the right margin of the sternum.

On the sound side the percussion resonance is often increased, owing to compensatory hypertrophy of the sound lung; the diaphragm is pushed down and the borders of the heart or of the liver may be encroached upon. When the hyper-resonance of the sound side is present, it should warn us to percuss lightly over the effusion, else we may bring out the resonance of the distended lung.

*Summary of Percussion Signs.*—(1) Flatness corresponding roughly to the position of the fluid.

(2) Tympany above the level of the fluid over the condensed lung.

(3) The level of the fluid is seldom quite horizontal.

(4) Shifting of the fluid with change of position is rare, slow, and has little or no importance in diagnosis.

*Exceptions and Possible Errors.*—(a) Great muscular pain and spasm may produce an area of dulness which simulates that of pleural effusions, especially as the auscultatory signs may be equally misleading. A hypodermic of morphine will dispel the dulness along with the pain if it is due to muscular cramp.

(b) If the lung on the affected side fails to retract (owing to

emphysema or adhesions to the chest wall), the area of dulness and its intensity will be much diminished.

(c) It must be remembered that dulness in Traube's space may be due to solidification of the lung, to *situs inversus*, to tumors, or to overfilling of the stomach and intestine with food, as well as to pleural effusion; also that the size of the tympanitic space varies greatly in health.

(d) Rarely percussion may be tympanitic over an effusion at the left base owing to distention of the stomach or colon.

(e) The diagnosis between fluid and thickened pleura will be considered later.

#### *Auscultation.*

The auscultatory phenomena vary greatly in different cases, and in the same case at different times, because the essential conditions are subject to similar variations. *Whatever sounds are produced in the lungs or in the bronchi may be heard over the fluid unless interfered with by inflammatory thickening of the costal pleura. Fluid transmits sounds well*, but there may be no breath sounds produced and hence none audible over the fluid. Or tubular sounds only may be produced because only the bronchi remain open, the rest of the lung being collapsed.

Or again, if râles or friction sounds are produced in the lung, they, too, may be transmitted to the fluid and may (alas!) deter the timid "observer" from tapping.

In about two-thirds of all large effusions no breathing at all is audible over the area of flatness on percussion. In the remaining third, and especially in children, tubular breathing, sometimes feeble, sometimes very intense, is to be heard.

In moderate effusions there are often three zones in the back. At the bottom we hear nothing, in the middle zone distant bronchial or broncho-vesicular breathing, while at the summit of the chest the breathing is normal.

The *voice sounds* correspond. When breath sounds are absent, the voice sounds are likewise absent. When the breathing is tubu-

lar, the voice, and especially the whisper, is also tubular and intensified. That is, *whenever the bronchi are open, the lung retracted, and the chest walls thin, the breathing, voice, and whisper will correspond to the tracheal and bronchial sounds.* Since children have especially thin chest walls, these bronchial sounds are especially frequent and intense in children.<sup>1</sup>

Near the angle of the scapula and in a corresponding position in front, the sound of the spoken voice may have a peculiar high-pitched, nasal twang, to which the term egophony is applied. This sign has no importance in diagnosis, since it is not constant, and not peculiar to fluid accumulations.

Râles are rarely produced in the retracted lung, and so are rarely to be heard over the fluid.

All these sounds may be diminished or abolished if the costal pleura is greatly thickened.

The influence of cough upon the lung, and so upon the sounds produced in it and transmitted through the fluid, may be very great and very puzzling. Râles may appear or disappear, breathing change in quality or intensity, and in the differential diagnosis of difficult cases the patient should always be made to cough and then breathe deeply before the examination is completed.

In very large effusions, when only the primary bronchi are open, there may be signs like those of pulmonary cavity at the site of the bronchi in front or behind (amphoric breathing, large metallic râles, etc.). Over the sound lung the breathing is exaggerated and extends unusually far down in the back and axilla, owing to hypertrophy of the lung.

The heart sounds may be absent at the apex owing to dislocation of the heart. In left-sided effusions the apex sounds are often loudest near the ensiform cartilage or beyond the right margin of the sternum. Right-sided effusions have much less effect upon the heart, but occasionally we find the heart sounds loudest at the left of the nipple or in the axilla.

Since many cases of pleural effusion are due to tuberculosis, we

<sup>1</sup> Bacelli's theory—that the whispered voice is conducted through serum but not through pus—is not borne out by facts.

should never omit to search for evidences of this disease at the apex of the lung on the *sound* side, since experience has shown that phthisis is more apt to begin here than on the side of the effusion.

*Summary of Auscultatory Signs.*

(1) In most cases voice and breath sounds are absent or very feeble over the area occupied by the fluid.

(2) In a minority of the cases the breathing and voice sounds may be tubular and intensified, especially in children.

(3) Over the condensed lung at the summit of the chest the breathing is bronchial or broncho-vesicular, according to the degree of condensation. If the amount of fluid is small, the layer of condensed lung occupies the middle zone of the chest and the breathing is normal at the top of the chest.

(4) Râles and friction sounds are rarely heard over fluid.

(5) On the sound side the breathing is exaggerated.

(6) The heart sounds may be absent at the apex and present in the left axilla or to the right of the sternum owing to dislocation of the heart.

*Inspection and Palpation.*

The most important information given us by inspection and palpation relates to the displacement of various organs by the pressure of the accumulated fluid. In left-sided pleuritic effusions the heart is usually displaced considerably toward the right, even when the level of the fluid reaches no higher than the sixth rib in the nipple line. The apex impulse is to be seen and felt to the right of the sternum, somewhere between the third and the seventh rib, when a large amount of fluid is present. With smaller effusions one may find the apex beat lifting the sternum or close to its left border. The position of the heart may be confirmed by percussion.

The spleen is scarcely ever displaced.

Right-sided effusions are far less likely to displace the heart, and it is only when a large amount of fluid is present that the apex of the heart is pushed outward beyond the nipple. Moderate right-sided effusions often produce no dislocation of the heart whatever. The liver is often considerably pushed down by a right-sided pleu-

ritic effusion, and its edge may be palpable several inches below the costal margin. Its upper margin cannot be determined by percussion, as it merges into the flatness produced by the fluid accumulation above it.

*Tactile fremitus* is almost invariably absent or greatly diminished over the areas corresponding to the fluid; just above the level of the fluid it is often increased.

Occasionally a slight fulness of the affected side may be recognized by inspection, and the interspaces may be less readily visible than upon the sound side. Bulging of the interspaces I have never observed. When the accumulation of fluid is large the respiratory movements upon the affected side are somewhat diminished,<sup>1</sup> the shoulder is raised, and the spine curved toward the affected side. The diaphragm is depressed, and Litten's sign therefore absent.

There are no reliable means for distinguishing purulent from serous effusions. The whispered voice may be transmitted through either pus or serum. But we know that in children two-thirds of all effusions are purulent, while in adults three-fourths of them are serous.

*Physical Signs During Absorption of Pleural Effusions.*

When the fluid begins to disappear, either spontaneously or as a result of treatment, the dulness very gradually disappears and the breath sounds, voice sounds, and fremitus reappear. In case the heart has been dislocated, its return to its normal position is often much slower than one would anticipate, and indeed all the physical signs are disappointingly slow to clear up even after tapping. Pleural friction appears when the roughened pleural surfaces, which have been held apart by the fluid, are allowed by the disappearance of the latter to come into apposition again. Owing to pulmonary atelectasis and permanent thickening of the pleura, considerable dulness often remains for weeks after the fluid has been absorbed.

<sup>1</sup>I have purposely made but little of the changes in the shape of the chest produced by pleuritic effusions, as it has seemed to me that by far too much stress has usually been laid upon such signs.

(c) PLEURAL THICKENING.

In persons who have previously suffered from pleurisy with effusion, and in many who have never to their knowledge had any such trouble, a considerable thickening of the pleural membrane with adhesion of the costal and visceral layers may be manifested by the following signs:

- (1) Dulness on percussion, sometimes slight, sometimes marked.
- (2) Diminished vesicular respiration.
- (3) Diminished voice sounds and tactile fremitus.
- (4) Absence of Litten's phenomenon and diminution in the normal respiratory excursion of the chest.

These signs are most apt to be found at the base of the lung behind and in the axilla. Occasionally a similar thickening may be demonstrated throughout the whole extent of the pleura, and the lung failing to expand, the chest may fall in as a result of atmospheric pressure (see Fig. 51).

The ribs approximate and may overlap, the spine becomes curved, the shoulder lowered, the scapula prominent, and the whole side shrunken. The heart may be drawn over toward the affected side.

In the diagnosis of pleural thickening Rosenbach's "palpatory puncture" is sometimes our only resource. Under antiseptic precautions a hollow needle is pushed between the ribs and into the pleural cavity. As the needle forces its way through the tough fibrous, or perhaps calcified, pleura, the degree and kind of resistance are very enlightening. Again, the amount of mobility of the point after the chest wall has been pierced tells us whether the needle is free in a cavity, entangled in a nest of adhesions, or fixed in a solid "carnified" lung. There is no danger if the needle is sterile.

ENCAPSULATED PLEURAL EFFUSION.

Small accumulations of serum or pus may be walled off by adhesions so that the fluid does not gravitate to the lowest part of the pleural cavity or spread itself laterally as it would if free.

Such localized effusions are most apt to be found in the lower axillary regions or behind—sometimes between the base of the lung and the diaphragm, and more rarely between the lobes of one of the lungs or higher up. I have twice seen an encapsulated purulent effusion so close to the left margin of the heart that the diagnosis of pericardial effusion was made.

The diagnosis of encapsulated pleural effusion is a difficult one and oftentimes cannot be made except by puncture. The signs are those of fluid in the pleura, but anomalously placed. Even puncture may fail to clear up the difficulty, since the needle may pass entirely through the pouch of fluid and into some structure behind so that no fluid is obtained.

#### PULSATING PLEURISY (EMPHYEMA NECESSITATIS).

Under conditions not altogether understood the movements transmitted by the heart to a pleural effusion (usually purulent) may be visible externally as a circumscribed pulsating swelling near the precordial region, or as a diffuse undulation of a considerable portion of the chest wall. Sometimes this pulsation is visible because the fluid has worked its way out through the thoracic wall and is covered only by the skin and subcutaneous tissues, but occasionally pulsation in a pleural effusion becomes visible, although no such perforation of the chest wall has occurred.

The condition is a rare one, and is of importance only because it may be mistaken for an aneurism, from which, however, it should be readily distinguished by the absence of a palpable thrill or diastolic shock and by the evidence of fluid in the pleura.

#### DIFFERENTIAL DIAGNOSIS OF PLEURITIC EFFUSION.

The following conditions are not infrequently mistaken for pleuritic effusion:

- (1) Croupous pneumonia with occlusion of the bronchi.
- (2) Pleural thickening, with pulmonary atelectasis.
- (3) Subdiaphragmatic abscess or abscess of the liver.

In croupous pneumonia with plugging of the bronchi one may

have present all the physical signs of pleuritic effusion *except displacement of the neighboring organs*. The presence or absence of such displacement, together with the history, symptoms, and course of the case, is therefore our mainstay in distinguishing the two diseases.

From *ordinary* croupous pneumonia (without occlusion of the bronchi) pleuritic effusion differs in that it produces a greater degree of dulness and a diminution of the spoken voice sounds and tactile fremitus. Bronchial breathing and bronchial whisper may be heard either over solid lung or over fluid accumulation, although the bronchial sounds are usually feeble and distant in the latter condition. The displacement of the neighboring organs is of importance here as in all diagnoses in which pleuritic effusion is a possibility. In pleuritic effusion we can sometimes determine that the line marking the upper limit of dulness shifts with change of the patient's position. This is, of course, impossible in pneumonia. A few hard coughs may open up an occluded bronchus and so clear up the diagnosis at once. In doubtful cases the patient should always be made to cough and breathe deeply before the examination is finished.

It should always be remembered that one may have both pneumonia and pleuritic effusion at the same time, and that pneumonia is often followed by a purulent effusion. In children the bronchi are especially prone to become occluded even as a result of a simple bronchitis, and we must then differentiate between atelectasis and effusion—in the main by the use of the criteria just described.

(2) It is sometimes almost impossible to distinguish small fluid accumulations in the pleural cavity from pleural thickening with pulmonary atelectasis. In both conditions one finds dulness, diminution of the voice sounds, respiration, and tactile fremitus, and absence of Litten's phenomenon, but the tactile fremitus is usually more diminished when fluid is present than in simple pleural thickening and atelectasis. An area of dulness which shifts with change of position points to pleuritic effusion. The presence of friction sounds over the suspected area speaks strongly in favor of pleural thickening, but it is possible to hear friction sounds over fluid,

probably because they are conducted from a point higher up in the chest at which no fluid is present. In doubtful cases the diagnosis can and should be cleared up by *puncture*.

(3) In two cases I have known enlargement of the liver due to multiple abscesses to be mistaken for empyema. In both conditions, one finds in the right back dulness on percussion as high as mid-scapula, with absence of voice sounds, breath sounds, and fremitus. These conditions are due in one case to the presence of fluid between the lung and the chest wall, and in the other case to

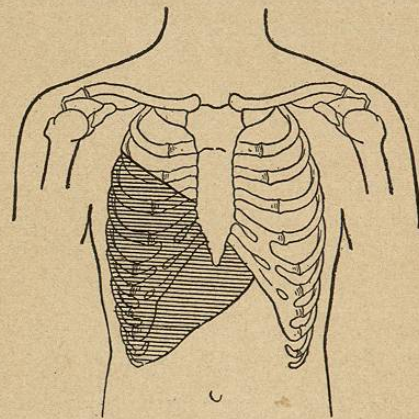


FIG. 175.—Area of Dulness in Solitary (tropical) Abscess of the Liver.

the liver which pushes up the lung together with the diaphragm. By physical signs alone I do not see how this diagnosis is possible, though Litten's sign may be of use, since the shadow is absent in empyema and sometimes present in moderate-sized subdiaphragmatic accumulations. Some of the symptoms, such as chills, sweating, and irregular fever, are common to both conditions. A careful consideration of the history and the associated signs and symptoms may help us to decide.

Large solitary abscess of the liver, occurring as it almost invariably does in the posterior portion of the right lobe, produces an area of flatness on percussion, which rises to a much higher level in

the axilla and back than in front or near the sternum (see Fig. 175), and may be in this way distinguished from empyema; but when the liver contains many small abscesses, as in suppurative cholangitis, this peculiar line of dulness is not present.

(d) Rare diseases, such as cancer or hydatid of the lung, may be mistaken for pleuritic effusion. The history of the case and the results of exploratory puncture usually clear up the difficulty.

#### *Examination of Exudates and Transudates.*

Only such methods as can be carried out without a thermostat will be here described. Hence the examination of diphtheria swabs, blood cultures, and pus are excluded. We have left the

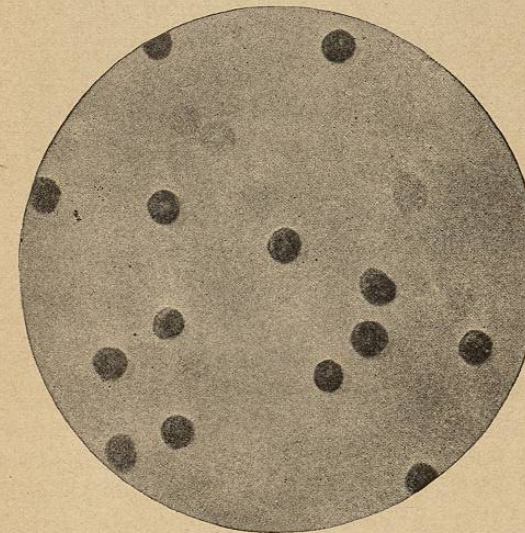


FIG. 176.—Lymphocytosis in Pleural Fluid. Primary tuberculous pleurisy. ( $\times 750$  diameters.) (Musgrave.)

fluids obtained by tapping the pleura, the peritoneum, and the spinal cord. The first is the most important.

*Pleural Fluids.*—A fluid withdrawn from the pleura by puncture may be a mechanical transudate (hydrothorax), may be evidence of *tuberculous pleurisy* (primary or associated with phthisis), or, rarely, an exudate of septic or cancerous origin.

To investigate these fluids we note:

1. *Color.* Bloody fluids suggest cancer, but occasionally occur in pneumonia and tuberculosis.

2. *Weight.*<sup>1</sup> Dropsical fluid is generally below 1.015 in specific

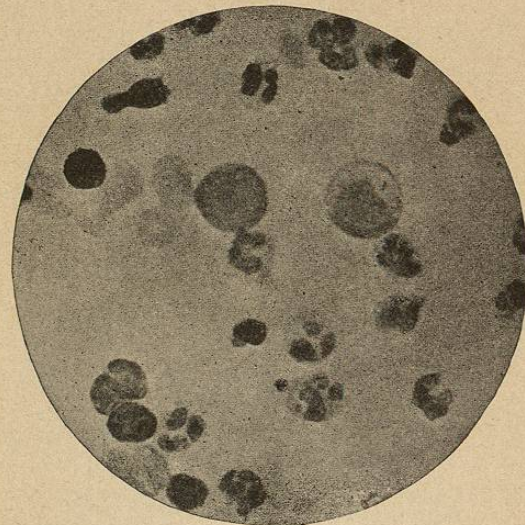


FIG. 177.—Polynuclears and Large Lymphocytes in Pleural Fluid from a Case of Traumatic Acute Infectious Pleurisy. ( $\times 750$  diameters.) (Musgrave.)

gravity. Exudates are usually in the vicinity of 1.020. An ordinary specific-gravity bulb is used.

3. *The cells of the sediment* (cytodiagnosis).

*Technique of Cytodiagnosis.*—1. Pour fluid into tubes of a centrifuge and centrifugalize five minutes.

2. Pour off the supernatant fluid and stir up the sediment with

<sup>1</sup>The amount of albumin usually runs parallel with the weight of the fluid.

a platinum loop, so as to suspend the sediment in the few remaining drops.

3. Spread a drop of the mixture on a *clean cover glass* with the platinum loop and let the smear dry without heating it.

4. Stain like a blood film (see below, page 469) with the follow-

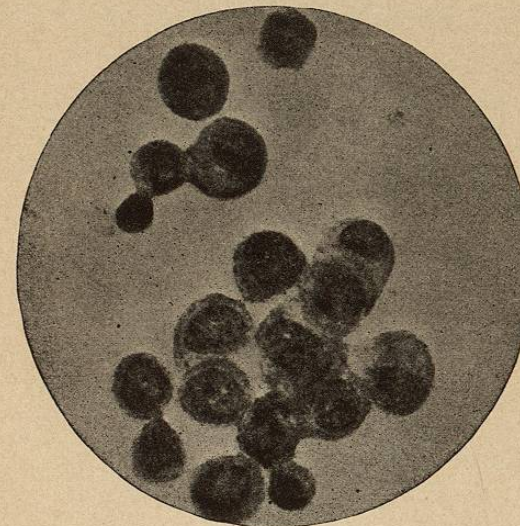


FIG. 178.—Pleural Fluid in Hydrothorax Due to Cardiac Disease. Endothelial plaques and cells. ( $\times 750$  diameters.) (Musgrave.)

ing mixture:<sup>1</sup> Wright's modification of Leishman's stain, 3 parts; pure methyl alcohol, 1 part.

5. After staining, wash *very gently*, using a dropper (else the whole film may be pushed off), and dry *in the fingers* over a Bunsen or alcoholic flame. Do not blot the preparation.

6. Mount in Canada balsam and examine with an oil-immersion lens.

*Interpretation of Results.*—(a) In *tuberculous pleurisy*, lympho-

<sup>1</sup>Suggested by Musgrave: Boston Med. and Surg. Journ., vol. cli., p. 319, 1904.

*cytes* make up from seventy to ninety-nine per cent—usually over ninety per cent—of all the cells found in the smear (see Fig. 176).

(b) In septic cases due to the streptococcus, staphylococcus, or pneumococcus the majority of the cells are *polynuclear* leucocytes (see Fig. 177).

(c) In *transudations* (dropsical) the predominating cell is a large mononuclear type, apparently endothelial in origin and often occurring in sheets or "*plaques*" (see Fig. 178).

Exceptions occasionally occur, but in the main these rules are sufficiently exact to be of value in diagnosis when taken in connection with all the facts in the case.

In *peritoneal fluid* the use of cytodagnosis has not as yet furnished information of any considerable diagnostic value.

In cerebrospinal fluid obtained by lumbar puncture the predominance of lymphocytes has not the same association with tuberculosis as it has in the pleura, and seems to point to nothing more definite than cerebrospinal irritation from any cause.

## CHAPTER XVII.

### ABSCESS, GANGRENE, AND CANCER OF THE LUNG, PULMONARY ATELECTASIS, ŒDEMA, AND HYPO- STATIC CONGESTION.

#### ABSCESS AND GANGRENE OF THE LUNG.

I CONSIDER these two affections together because the physical signs, exclusive of the sputa, do not differ materially in the two affections. In some cases there may be no physical signs at all, and the diagnosis is made from the character of sputa and from a knowledge of the etiology and symptomatology of the case. In other cases we find nothing more than a patch of coarse râles or a small area of solidification, over which distant bronchial breathing, with increased voice sound and fremitus, may be appreciated. Rarely there may be slight dulness on percussion, but as a rule the area is not sufficiently large or sufficiently superficial to produce this. One may find the signs of cavity (amphoric breathing, cracked-pot resonance, and gurgling râles), but this is unusual.

Gangrene of the lung is not a common disease. The diagnosis usually rests altogether upon the smell and appearance of the sputa. In fetid bronchitis one may have sputa of equal foulness, but the odor is different. The finding of elastic tissue in the sputa proves the existence of something more than bronchitis.

Pulmonary abscess, which, like gangrene, is a rare affection, is often simulated by the breaking of an empyema into the lung and the emptying of the pus through a bronchus. Large quantities of pus are expectorated in such a condition, and abscess of the lung is suggested, but the other physical signs are those of empyema and should be easily recognized as such. The finding of *elastic fibres* is the crucial point in the diagnosis of intrapulmonary abscess,