

an area of lung superficially that fine distinctions of note are made impossible (see above, p. 123).

Good observers are to be found on each side of this question, and I have no doubt that either method works well in skilled hands. Personally I have found light percussion preferable.

Whatever method we use we must percuss successive points along a line running at right angles to the border of the organ which we wish to outline until a change of note is perceived. Thus, if we wish to percuss out the upper border of the liver, we strike successive points along a line running parallel to the sternum and about an inch to the right of it.<sup>1</sup> When a change of note is perceived, the point should be marked with a skin pencil; then we percuss along a line parallel to the first one, and perhaps an inch farther out, and again mark with a dot the point at which the note first changes. A line connecting the points so marked upon the skin represents the border of the organ to be outlined.

If now we look at the upper part of the chest in Fig. 81, we notice at once that the two sides are not shaded alike: the left apex is distinctly lighter colored than the right. This is a very important point and one not sufficiently appreciated by students. The apex of the normal right lung is distinctly less resonant than the apex of the left in a corresponding position.

In percussing at the bottom of the left axilla, we come upon a small oval area of dulness corresponding to that outlined in Fig. 82. This is the area of *splenic dulness*, so called, and corresponds to that portion of the spleen which is in contact with the chest wall. This dull area is to be made out only in case the stomach and colon are not overdistended with air. When these organs are full of gas as is not infrequently the case, there is no area of splenic dulness and the whole region gives forth, when percussed, a note of a quality next to be described, namely, "*tympanitic*."

(c) Tympanitic resonance is that obtained over a hollow body, like the stomach when moderately distended with air.<sup>2</sup> It is usu-

<sup>1</sup>Or we may reverse the procedure; percuss first over the liver and then work toward the lung above until the note becomes more resonant.

<sup>2</sup>*Extreme* distention here, as in a snare drum, is associated with a dull percussion note (see below, p. 332).

ally of a higher pitch than the resonance to be obtained over the normal lung, and may be elicited by percussion lighter than that needed to bring out the lung resonance. It differs also from the vesicular or pulmonary resonance in *quality*, in a way easy to appreciate but difficult to describe. Tympanitic resonance is usually to be heard when one percusses over the front of the left chest near the ensiform cartilage and for a few inches to the left of this point over an area corresponding with that of the stomach more or less distended with air. This tympanitic area, known as "*Traube's semilunar space*," varies a great deal in size according to the contents of the stomach. It is bounded on the right by the liver flatness, above by the pulmonary resonance, on the left by the splenic dulness, and below by the resonance of the intestine, which is also tympanitic, although its pitch is different owing to the different size and shape of the intestine.

(The right axilla shows normal lung resonance down to the point at which the liver flatness begins, as shown in Fig. 81.)

In the back, when the scapulæ are drawn forward, as shown in Fig. 78, page 124, percussion elicits a clear vesicular resonance from top to bottom on each side, although the top of the right lung is always slightly less resonant than the top of the left, and sometimes the bottom of the right lung is slightly less resonant than the corresponding portion of the left, on account of the presence of the liver on the right.

It should be remembered, however, that in the majority of cases the resonance throughout the back is distinctly less than that obtained over the front, on account of the greater thickness of the back muscles. Yet in children or emaciated persons, or where the muscular development is slight, there may be as much resonance behind as in front.

*Importance of Percussing Symmetrical Points.*—Since we depend for our standard of resonance upon comparison with a similar spot on the outside of the chest, it is all-important that in making such comparisons we should percuss symmetrical points, and not, for example, compare the resonance over the third rib in the right front with that over the third interspace on the left, since more resonance can always be elicited over an interspace than over a rib. This

comparison of symmetrical points, however, is interfered with by the presence of the heart on one side and the liver on the other, as well as by the fact that the apex of the right lung is normally less resonant than that of the left. A resonance which would be pathologically feeble if obtained over the left top may be normal over the right. Where both sides are abnormal, as in bilateral disease of the lung, or where fluid accumulates in both pleural cavities, we have to make the best comparison we can between the sound in the given case and an ideal standard carried in the mind.

It must always be remembered that the amount of resonance obtained at any point by percussion depends upon how hard one strikes, as well as upon the conditions obtaining within the chest. A powerful blow over a diseased lung may bring out more resonance than a lighter blow over a normal lung. To strike with perfect fairness and with equal force upon each side can be learned only by considerable practice. Furthermore, the distance from the ear to each of the two points, the resonance of which we are comparing, must be the same—that is, we must stand squarely in front or squarely behind the patient, otherwise the note coming from the part farther from the ear will sound duller than that coming from the nearer side.

The normal resonance of the different parts of the chest can be considerably modified by the position of the patient, by deep breathing, by muscular exertion, and by other less important conditions. If, for example, the patient lies upon the left side, the heart swings out toward the left axilla and its dulness is extended in the same direction. Deep inspiration pushes forward the margins of the lungs so that they encroach upon and reduce the area of the heart dulness and liver dulness. After muscular exertion the lungs become more than ordinarily voluminous, owing to the temporary distention brought about by the unusual amount of work thrown upon them.

The area of cardiac dulness is increased in any condition involving insufficient lung expansion. Thus, in children, in debility, chlorosis, or fevers, the space occupied by the lungs is relatively small and the dull areas corresponding to the heart and liver are

proportionately enlarged. In old age, on the other hand, when the lungs have lost part of their elasticity and sag down over the heart and liver, the percussion dulness of these organs is reduced.

*Conditions Modifying the Percussion Note in Health.*—The development of muscle or fat as well as the thickness of the chest wall will influence greatly the amount of resonance to be obtained by percussion. Indeed, we see now and then an individual in no part of whose chest can any clear percussion tone be elicited. In women, the amount of development of the breasts has also great influence upon the percussion note. In children, the note is generally clearer, and only the lightest percussion is to be used on account of the thinness of the chest wall. In old people whose lungs are almost always more or less emphysematous, a shade of tympanitic quality is added to the normal vesicular resonance. The distention of the colon with gas may obliterate the liver dulness by rotating that organ so that only its edge is in contact with the chest wall, and if there is wind in the stomach, a variable amount of tympany is heard on percussing the lower left front and axilla or even in the left back.

If a patient is examined while lying on the side the amount of resonance over the lung corresponding to the side on which he lies is usually less than that of the side which is uppermost, because there is more air in the latter. Whatever the patient's position, the amount of resonance is also greater at the end of inspiration than at the end of expiration, for the reason just given. As the lungs expand with full inspiration, their borders move so as to cover a larger portion of the organs which they normally overlap. Portions of the chest which at the end of expiration are dull or flat, owing to the close juxtaposition of the heart, liver, or spleen, become resonant at the end of inspiration. For example, the lower margin of the right lung moves down during inspiration so as to cover a considerably larger portion of the liver.

*Percussion as a Means of Ascertaining the Movability of the Lung Borders.*—It is often of great importance to determine not merely the position of the resting lung but its power to expand freely. This can be ascertained by percussion in the following way: The

lower border of the lung resonance, say in the axilla, is carefully marked out. Then percussion is made over a point just *below* the level of the resting lung and at the same time the patient is directed to inspire deeply. If the lung expands and its border moves down, the percussion note will change suddenly from dull to resonant during the inspiration. An excursion of two or three inches can often be demonstrated by this method, which is especially important for the anterior and posterior margins of the lung. In the axilla Litten's phrenic shadow will give us the same information.

The mobility of the borders of the lung, as determined by this method, is of considerable clinical importance, for an absence of such mobility may indicate pleuritic adhesions. Its amount depends upon various conditions and varies much in different individuals, but complete absence of mobility is always pathological.

(d) *Cracked-Pot Resonance*

When percussing the chest of a crying child, we sometimes notice that the sound elicited has a peculiar "*chinking*" quality, like that produced by striking one coin with another, but more muffled. The sound may be more closely imitated, and the mode of its production illustrated, by clasping the hands palm to palm so as to enclose an air space which communicates with the outer air through a chink left open, and then striking the back of the under hand against the knee. By the blow, air is forced out through the chink with a sound like that of metallic coins struck together.

In disease, the cracked-pot sound is usually produced over a pulmonary cavity (as in advanced phthisis) from which the air is suddenly and forcibly expelled by the percussion stroke.

It is much easier to hear this peculiar sound if, while percussing, one listens with a stethoscope at the patient's open mouth. The patient himself holds the chest piece of the instrument just in front of his open mouth, leaving the auscultator's hands free for percussing.

(e) *Amphoric Resonance.*

A low-pitched hollow sound approximating in quality to tympanitic resonance, and sometimes obtained over pulmonary cavities or over pneumothorax, has received the name of amphoric resonance. It may be imitated by percussing the trachea or the cheek when moderately distended with air.

*Summary*

The varieties of resonance to be obtained by percussing the normal thorax are:

- (1) *Vesicular resonance*, to be obtained over normal lung tissue.
- (2) *Tympanitic resonance*, to be obtained in Traube's semilunar space
- (3) *Diminished resonance* or *dulness*, such as is present over the scapulæ, and
- (4) *Absence of resonance* or *flatness*, such as is discovered when we percuss over the lowest ribs in the right front.
- (5) *Cracked-pot resonance*, sometimes obtainable over the chest of a crying child.
- (6) *Amphoric resonance*, obtainable over the trachea.

Any of these sounds may denote disease if obtained in portions of the chest where they are not normally found. *Each has its place, and becomes pathological if found elsewhere.* Tympanitic resonance is normal at the bottom of the left front and axilla, but not elsewhere. Dulness or flatness is normal over the areas corresponding to the heart, liver, and spleen, and over the scapulæ, but not elsewhere unless the muscular covering of the chest is enormously thick. Vesicular resonance is normal over the areas corresponding to the lungs, but becomes evidence of disease if found over the cardiac or hepatic areas.

Cracked-pot resonance may be normal if produced while percussing the chest of a child, but under all other conditions, so far as is known, denotes disease.

Amphoric resonance always means disease, usually pulmonary cavity or pneumothorax, if found elsewhere than over the trachea.

*(f) The Lung Reflex.*

It must also be remembered, when percussing, that in some cases every forcible percussion blow increases the resonance to be obtained by subsequent blows. Any one who has demonstrated an area of percussion dulness to many students in succession must have noticed occasionally that the more we percuss the dull area, the more resonant it becomes, so that to those who last listen to the demonstration the difference which we wish to bring out is much less obvious than to those who heard the earliest percussion strokes. Abrams has referred to this fact under the name of the "lung reflex," believing, partly on the evidence of fluoroscopic examination, that if an irritant such as cold or mustard is applied to any part of the skin covering the thorax, the lung expands so that a localized temporary emphysema is produced in response to the irritation. Apparently percussion has a similar effect.

## III. SENSE OF RESISTANCE.

While percussing the chest we must be on the lookout not only for changes in resonance, but for variations in the amount of resistance felt underneath the finger. Normally the elasticity of the chest walls over the upper fronts is considerably greater and the sense of resistance considerably less than that felt over the liver. In the axillæ and over those portions of the back not covered by the scapulæ, we feel in normal chests an elastic resistance when percussing which is in contrast with the dead, woodeny feeling which is communicated to the finger when the air-containing lung is replaced by fluid or solid contents (pleuritic effusion, pneumonia, phthisis, etc.). In some physicians this sense of resistance is very highly developed and as much information is obtained thereby as through the sounds elicited. As a rule, however, it is only by long practice that the sense of resistance is cultivated to a point where it becomes of distinct use in diagnosis.

## CHAPTER VII.

## AUSCULTATION.

AUSCULTATION may be practised by placing one's ear directly against the patient's chest (immediate auscultation) or with the help of a stethoscope (mediate auscultation).

Each method has its place. Immediate auscultation is said to have advantages similar to those of the low power of the microscope, in that it gives us a general idea of the condition of a relatively large area of tissue, while the stethoscope may be used, like the oil immersion lens, to bring out details at one or another point.

On the other hand, I have heard it said by E. G. Janeway and other accomplished diagnosticians that the unaided ear can perceive sounds conducted from the interior of the lung—sounds quite inaudible with any stethoscope—and that in this way deep-seated areas of solidification may be recognized.

Immediate auscultation may be objected to

(a) On grounds of *delicacy* (when examining persons of the opposite sex).

(b) On grounds of *cleanliness* (although the chest may be covered with a towel so as to protect the auscultator to a certain extent).

(c) Because we cannot conveniently reach the supraclavicular or the upper axillary regions in this way.

(d) Because it is difficult to localize the different valvular areas and the sites of cardiac murmurs if immediate auscultation is employed.

On account of the latter objection the great majority of observers now use the stethoscope to examine the heart. For the lungs, both methods are employed by most experienced auscultators.