

in any condition involving either profound unconsciousness or very great weakness, so that the secretions which accumulate in the trachea are not coughed out. Tracheal râles are by no means a sure precursor of death, although they are very common in the moribund state. They can usually be heard at some distance from the patient and without a stethoscope. In catarrh of the larger



FIG. 107.—Explosion of Fine Râles at End of Inspiration.

bronchi large bubbling râles are occasionally to be heard. In phthisical cavities one sometimes hears coarse, bubbling râles of a very metallic and gurgling quality (see below, p. 311). The finer grades of moist râles correspond to the finer bronchi. In the majority of cases moist râles are most numerous during inspiration and especially during the latter part of this act. Their relation to respiration may be represented graphically as in Fig. 107, using large dots for coarse râles and small dots for fine râles. Musical râles can be symbolized by the letter *S* (squeaks).

#### (2) Crackling Râles.

These differ from the preceding variety merely by the absence of any distinct bubbling quality. They are usually to be heard in cases of bronchitis in which the secretions are unusually *tenacious and viscid*. They are especially apt to come at the end of inspiration, a large number being evolved in a very short space of time, so that one often speaks of an "explosion of fine crackling râles" at the end of inspiration. Crackling râles are to be heard in any one of the conditions in which bubbling râles occur, but are more frequent in tuberculosis than in simple bronchitis.

*Crepitant râles*, which represent the finest sounds of this type, are very much like the noise which is heard when one takes a lock of hair between the thumb and first finger and rubs the hairs upon each other while holding them close to the ear. A very large number of minute crackling sounds is heard following each other in rapid succession. To the inexperienced ear they may seem to blend into a continuous sound, but with practice the component parts may

be distinguished. This type of râles is especially apt to occur during inspiration alone, but not very infrequently they are heard during expiration as well. From subcrepitant râles they are distinguished merely by their being still finer than the latter.<sup>1</sup> Subcrepitant râles are often mixed with sounds of a somewhat coarser type, while crepitant râles are usually all of a size. If the chest is covered with hair, sounds precisely like these two varieties of râles may be heard when the stethoscope is placed upon the hairy portions. To avoid mistaking these sounds for râles one must thoroughly wet or grease the hair.

#### *Crepitant Râles in Atelectasis.*

Crepitant and subcrepitant râles are very often to be heard along the thin margins of the lungs at the base of the axillæ and in the back, especially when a patient who is breathing superficially first begins to take deep breaths. In such cases, they usually disappear after the few first respirations, and are then to be explained by the tearing apart of the slightly agglutinated surfaces of the finer bronchioles.

It is by no means invariably the case, however, that such subcrepitant râles are merely transitory in their occurrence. In a large number of cases they persist despite deep breathing. The frequency of subcrepitant râles, persistent or transitory, heard over the inferior margin of the normal lung at the bottom of the axilla, is shown by the following figures: Out of 356 normal chests to which I have listened especially for these râles, I found 228, or 61 per cent, which showed them on one or both sides. They are very rarely to be heard in persons under twenty years of age. After forty-five, on the other hand, it is unusual *not* to find them. In my experience they are considerably more frequent in the situation shown in Fig. 158 than in any other part of the lung, but they may be occasionally heard in the back or elsewhere. In view of

<sup>1</sup> A distinction was formerly drawn between crepitant and subcrepitant râles, on the ground that the latter were heard during both respiratory sounds and the former only during inspiration, but this distinction cannot be maintained and is gradually being given up.



these facts, it seems to me that we must recognize that it is almost if not quite physiological to find the finer varieties of crackling râles at the base of the axillæ in persons over forty years old. I have supposed these râles to be due to a partial atelectasis resulting from disease in the thin lower margin of the lungs. Such portions of the lung are ordinarily not expanded unless the respirations are forced and deep. This explanation would agree with the observations of Abrams, to which I shall refer later (see below, p. 359).

(b) Crepitant or subcrepitant râles are also to be heard in a certain portion of cases of pneumonia, in the very earliest stages and when resolution is taking place ("crepitans redux"). More rarely this type of râle may be heard in connection with tuberculosis, infarction, or œdema of the lung.

In certain cases of dry pleurisy there occur fine crackling sounds which can scarcely be differentiated from subcrepitant râles. I shall return to the description of them in speaking of pleural friction (see below, p. 336).

### (3) Musical Râles.

The passage of air through bronchial tubes narrowed by inflammatory swelling of their lining membrane (bronchitis), or by spasmodic contraction (asthma), gives rise not infrequently to a multitude of musical sounds. Such a stenosis occurring in relatively large bronchial tubes produces a deep-toned *groaning* sound, while narrowing of the finer tubes results in *piping*, *squeaking*, *whistling* noises of various qualities. Such sounds are often known as "*dry râles*" in contradistinction to the "*bubbling râles*" above described, but as many non-musical crackling râles have also a very dry sound, it seems to me best to apply the more distinctive term "*musical râles*" to all adventitious sounds of distinctly musical quality which are produced in the bronchi. Musical râles are of all adventitious sounds the easiest to recognize but also the most fugitive and changeable. They appear now here, now there, shifting from minute to minute, and may totally disappear from the chest and reappear again within a very short time. This is to some extent true of all varieties of râles, but especially of the squeaking and groaning varieties.

Musical râles are heard, as a rule, more distinctly during expiration, especially when they occur in connection with asthma or emphysema. In these diseases one may hear quite complicated chords from the combinations of râles which vary in pitch.

### VII. THE EFFECTS OF COUGH.

The influence of coughing upon râles is usually very marked. Its effect may be either to intensify them and bring them out where they have not previously been heard, or to clear them away altogether. Other effects of coughing upon physical signs will be mentioned later on in the chapters on Pneumonia and Phthisis.

### VIII. PLEURAL FRICTION.

The surfaces of the healthy pleural cavity are lubricated with sufficient serum to make them pass noiselessly over each other during the movements of respiration. But when the tissues become abnormally dry, as in Asiatic cholera, or when the serous surfaces are roughened by the presence of a fibrinous exudation, as in ordinary pleurisy, the rubbing of the two pleural surfaces against one another produces peculiar and very characteristic sounds known as "*pleural friction sounds*." The favorite seat of pleural friction sounds is at the bottom of the axilla, *i.e.*, where the lung makes the widest excursion and where the costal and diaphragmatic pleura are in close apposition (see Fig. 65). In some cases pleural friction sounds are to be heard altogether below the level of the lung. In others they may extend up several inches above its lower margin, and occasionally it happens that friction may be appreciated over the whole lung from the top to the bottom. Very rarely friction sounds are heard only at the apex of the lung in early tuberculosis.

The sound of pleural friction may be closely imitated by holding the thumb and forefinger close to the ear, and rubbing them past each other with strong pressure, or by pressing the palm of one hand over the ear and rubbing upon the back of this hand with



the fingers of the other. Pleural friction is usually a catchy, jerky, interrupted, irregular sound, and is apt to occur during inspiration only, and particularly at the end of this act. It may, however, be heard with both respiratory acts, but rarely if ever occurs during expiration alone. The intensity and quality of the sounds vary a great deal, so that they may be compared to *grazing, rubbing, rasping, and creaking* sounds. They are sometimes spoken of as "*leathery*." As a rule, they seem very near to the ear, and are sometimes startlingly loud. In many cases they cannot be heard after the patient has taken a few full breaths, probably because the rough pleural surfaces are smoothed down temporarily by the friction which deep breathing produces. After a short rest, however, and a period of superficial breathing, pleural friction sounds often return and can be heard for a short time with all their former intensity. They are increased by pressure exerted upon the outside of the chest wall. Such pressure had best be made with the hand or with the Bowles stethoscope, since the sharp edges of the chest-piece of the ordinary stethoscope may give rise to considerable pain; but if such pressure is made with the hand, one must be careful not to let the hand shift its position upon the skin, else rubbing sounds may thus be produced which perfectly simulate pleural friction. In well-marked cases pleuritic friction can be *felt* if the palm of the hand is laid over the suspected area; occasionally the sound is so loud that it can be heard by the patient himself or by those around him.

In doubtful cases, or when a friction sound appears to have disappeared, and when one wishes to bring it out again, there are several manœuvres suggested by Abrams for obtaining this end.

(a) *The Arm Manœuvre.*

The patient suspends respiration altogether, and the arm upon the affected side is raised over the head by the patient himself or by the physician, as in performing Sylvester's method of artificial respiration. During this movement we listen over the suspected area. "By this manœuvre the movement of the parietal against the visceral pleura is opposite in direction to that occurring during the

respiratory act, and for this reason the pleuritic sound may often be elicited after it has been exhausted in the ordinary act of breathing."

(b) *The Decubital Manœuvre.*

"Let the patient lie upon the affected side for a minute or two, then let him rise quickly and suspend respiration. Now listen over the affected area, at the same time directing the patient to take a deep breath."

Pleuritic friction sounds are distinguished from râles by their greater superficiality, by their jerky, interrupted character, by the fact that they are but little influenced by cough, and that they are increased by pressure. It has already been mentioned, however, that there is one variety of sounds which we have every reason to think originate in the pleura, which cannot be distinguished from certain varieties of crackling bronchial râles. Such sounds occur chiefly in connection with phthisical processes, in which both pleurisy and bronchitis are almost invariably present, and it is seldom of importance to distinguish the two.

IX. AUSCULTATION OF THE SPOKEN OR WHISPERED VOICE SOUNDS.

The more important of these is:

(a) *The Whispered Voice.*

The patient is directed to whisper "one, two, three," or "ninety-nine," while the auscultator listens over different portions of the chest to see to what degree the whispered syllables are transmitted. In the great majority of normal chests the whispered voice is to be heard only over the trachea and primary bronchi in front and behind, while over the remaining portions of the lung little or no sound is to be heard. When, on the other hand, solidification of the lung is present, the whispered voice may be distinctly heard over portions of the lung relatively distant from the trachea and bronchi; for example, over the lower lobes of the lung behind. The usefulness of the whispered voice in the search for small areas of solidification or for the exact boundaries of a solidi-



fied area is very great, especially when we desire to save the patient the pain and fatigue of taking deep breaths. Whispered voice sounds are practically equivalent to a forced expiration and can be obtained with very little exertion on the patient's part. The increased transmission of the whispered voice is, in my opinion, a more delicate test for solidification than tubular breathing. The latter sign is present only when a considerable area of lung tissue is solidified, while the increase of the whispered voice may be obtained over much smaller areas. Retraction of the lung above the level of a pleural effusion causes a moderate increase in the transmission of the whispered voice, and at times this increased or bronchial whisper is to be heard over the fluid itself, probably by transmission from the compressed lung above.

Where the lung is completely solidified the whispered words may be clearly distinguished over the affected area. In lesser degrees of solidification the syllables are more or less blurred.

(b) *The Spoken Voice.*

The evidence given us by listening for the spoken voice in various parts of the chest is considerably less in value than that obtained through the whispered voice. As a rule, it corresponds with the tactile fremitus, being increased in intensity by the same causes which increase tactile fremitus, viz., solidification or condensation of the lung, and decreased by the same causes which decrease tactile fremitus—namely, by the presence of air or water in the pleural cavity, by the thickening of the pleura itself, or by an obstruction of the bronchus leading to the part over which we are listening. In some cases the presence of solidification of the lung gives rise not merely to an increase in transmission of the spoken voice, but to a change in its quality, so that it sounds abnormally concentrated, nasal, and near to the listener's ear. The latter change may be heard over areas where tactile fremitus is not increased, and even where it is diminished. Where this change in the quality of the voice occurs, the actual words spoken can often be distinguished in a way not usually possible over either normal or solidified lung. "Bronchophony," or the distinct transmission

of audible words, and not merely of diffuse, unrecognizable voice sounds, is considerably commoner in the solidifications due to pneumonia than in those due to phthisis; it occurs in some cases of pneumothorax and pulmonary cavity.

(c) *Egophony.*

Among the least important of the classical physical signs is a nasal or squeaky quality of the sounds which reach the observer's ear when the patient speaks in a natural voice. To this peculiar quality of voice the name of "egophony" has been given. It is most frequently heard in cases of moderate-sized pleuritic effusion just about the level of the lower angle of the scapula and in the vicinity of that point. Less often it is heard at the same level in front. It is very rarely heard in the upper portion of the chest and is by no means constant either in pleuritic effusion or in any other condition. A point at which it is heard corresponds not, as a rule, with the upper level of the accumulated fluid, as has been frequently supposed, but often with a point about an inch farther down. The presence of egophony is in no way distinctive of pleuritic effusions and may be heard occasionally over solidified lung.

X. PHENOMENA PECULIAR TO PNEUMOHYDROTHORAX AND PNEUMOPYOTHORAX.

(1) *Succussion.*

Now and then a patient consults a physician, complaining that he hears noises inside him as if water were being shaken about. One such patient expressed himself to me to the effect that he felt "like a half-empty bottle." In the chest of such a patient, if one presses the ear against any portion of the thorax and then shakes the whole patient strongly, one may hear loud splashing sounds known technically as "*succussion*." Such sounds are absolutely diagnostic of the presence of *both air and fluid* in the cavity over which they are heard. Very frequently they may be detected by the physician when the patient is not aware of their presence. Oc-



asionally the splashing of the fluid within may be felt as well as heard. It is essential, of course, to distinguish succussion due to the presence of air and fluid in the pleural cavity from similar sounds produced in the stomach, but this is not at all difficult in the majority of cases. It is a bare possibility that succussion sounds may be due to the presence of air and fluid in the pericardial cavity.

It is important to remember that succussion is never to be heard in simple pleuritic effusion or hydrothorax. The presence of air, as well as liquid, in the pleural cavity is absolutely essential to the production of succussion sounds.<sup>1</sup>

(2) *Metallic Tinkle or Falling-Drop Sound.*

When listening over a pleural cavity which contains both air and fluid, one occasionally hears a liquid, tinkling sound, due possibly to the impact of a drop of liquid falling from the relaxed lung above into the accumulated fluid at the bottom of the pleural cavity, and possibly to râles produced in the tissues around the cavity. It is stated that this physical sign may in rare cases be observed in large-sized phthysical cavities as well as in pneumohydrothorax and pneumopyothorax.

(3) *The Lung-Fistula Sound.*

When a perforation of the lung occurs below the level of the fluid accumulated in the pleural cavity, bubbles of air may be forced out from the lung and up through the fluid with a sound reminding one of that made by children when blowing soap-bubbles.

<sup>1</sup> It is well for the student to try for himself the following experiment, which I have found useful in impressing these facts upon the attention of classes in physical diagnosis: Fill an ordinary rubber hot-water bag to the brim with water. Invert it and squeeze out forcibly a certain amount (perhaps half) of the contents, by grasping the upper end of the bag and compressing it. While the water is thus being forced out, screw in the nozzle of the bag. Now shake the whole bag, and it will be found impossible to produce any splashing sounds owing to the fact that there is no air in the bag. Unscrew the nozzle, admit air, and then screw it in again. Now shake the bag again and loud splashing will be easily heard.

## CHAPTER VIII.

### AUSCULTATION OF THE HEART.

#### I. "VALVE AREAS."

In the routine examination of the heart, most observers listen in four places:

(1) At the apex of the heart in the fifth intercostal space near the nipple, the "*mitral area*."

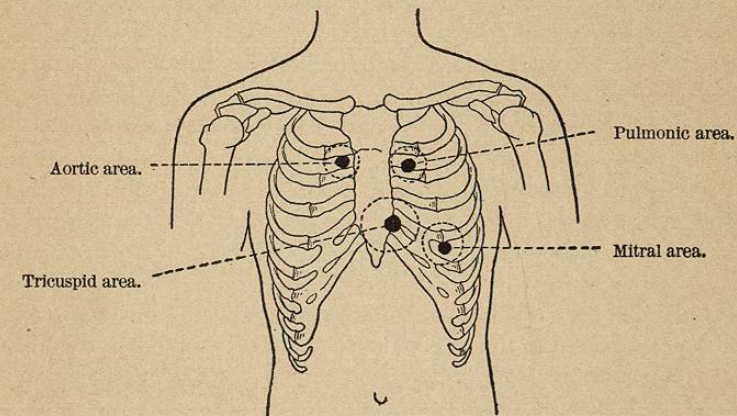


FIG. 108.—The Valve Areas.

(2) In the second left intercostal space near the sternum, the "*pulmonic area*."

(3) In the second right intercostal space near the sternum, the "*aortic area*."

(4) At the bottom of the sternum near the ensiform cartilage, the "*tricuspid area*."

These points are represented in Fig. 108 and are known as