(*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 deepseated 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.

(Personally, I have never yet learned to hear anything with my unaided ear which I could not hear better with a stethoscope, and the Bowles stethoscope seems to me to reach as large an area and as deep as the unaided ear. Nevertheless the weight of competent opinion is against me and greater experience will doubtless show me my mistake.)

While learning the use of immediate auscultation it is best to close with the fingers the ear which is not in contact with the chest. With practice one comes to disregard outer noises and does not need to stop the ear.

Mediate Auscultation.

1. *Selection of a Stethoscope.*

(1) It is as rash for any one to select a stethoscope without first trying the fit of the ear pieces in his ears as it would be to buy a new hat without trying it on. What suits A. very well is quite impossible for B. It is true that one can get used to almost any stethoscope as one can to almost any hat, but it is not necessary to do so. The ear pieces of the ordinary stethoscope are often too small and rarely too large. In case of doubt, therefore, it is better to err upon the side of getting a stethoscope with too large rather than too small ends.

(2) The binaural stethoscope, which is now almost exclusively used in this country, maintains its position in the ears of the auscultator either through the pressure of a rubber strap stretched around the metal tubes leading to the ears, or by means of a steel spring connecting the tubes. Either variety is usually satisfactory, but I prefer a stethoscope made with a steel spring (see Fig. 83) because such a spring is far less likely to break or lose its elasticity than a rubber strap. A rubber strap can always be added if this is desirable. It is important to pick out an instrument possessing a spring not strong enough to cause pain in the external meatus of the ear and yet strong enough to hold the ear pieces firmly in place. Persons with narrow heads need a much more powerful spring or strap than would be convenient for persons with wide heads.

(3) The rubber tubing used to join the metallic tubes to the chest piece of the instrument should be as flexible as possible (see Fig. 83). Stiff tubing (see Fig. 84) makes it necessary for the auscultator to move his head and body from place to place as the examination of the chest progresses, while if flexible tubing is used the head need seldom be moved and a great deal of time and fatigue is thus saved. Stiff stethoscopes are especially inconvenient when examining the axilla.

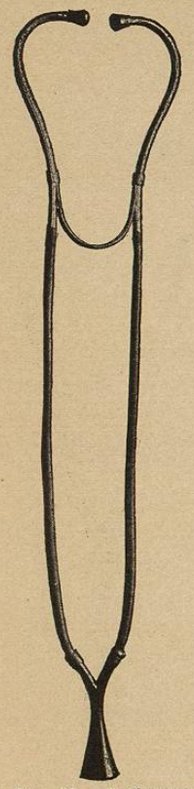

Fig. 83. — Stethoscope Fitted With Long Flexible Tubes, Especially Useful When Examining Children.

Fig. 84. — Camman Stethoscope With Stiff Tubing and Rubber Strap.

(4) Jointed stethoscopes which fold up or take apart should be scrupulously avoided. They are a delusion and a snare, apt to come apart at critical moments, and to snap and creak at the joints when in use, sometimes producing in this way sounds which may be easily mistaken for râles. Such an instrument is no more portable nor compact than the ordinary form with flexible tubes. It has, therefore, no advantages over stethoscopes made in one piece and possesses disadvantages which are peculiarly annoying.

(5) *The Chest Piece.*—The majority of the stethoscopes now in use have a chest piece of hard-rubber or wood with a diameter of about seven-eighths of an inch. Chest pieces of larger diameter than this are to be avoided as they are very difficult to maintain in close apposition with thin

chests. To avoid this difficulty the chest piece is sometimes made of soft-rubber or its diameter still further reduced.

(6) *The Bowles Stethoscope.*—(See Figs. 85 and 86). Within the last year there has been introduced an instrument which, for most purposes, seems to me far superior to any other form of stethoscope with which I am acquainted. Its peculiarity is the chest piece, which consists of a very shallow steel cup (see Fig. 87) over the mouth of which a thin metal plate or a bit of pigskin is fastened. The metal or pigskin diaphragm serves simply to prevent the tissues of the chest from projecting into the shallow cup of the chest piece when the latter is pressed against the chest, and does not in any other way contribute to the sounds which we hear with the instrument. This is proved by the fact that we can hear as well even when the diaphragm is cracked across in several directions.

FIG. 85.—Bowles' Stethoscope. Front view.

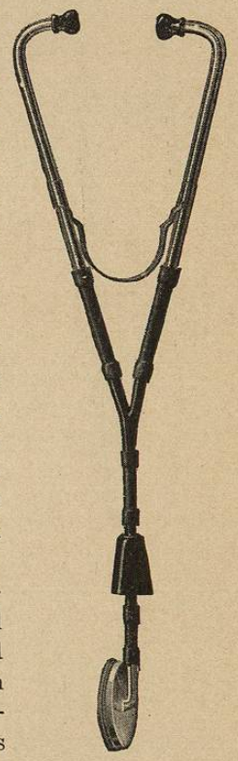

FIG. 86.—Combination Bowles' Stethoscope.

With this instrument almost all sounds produced within the chest can be heard much more distinctly than in any other variety of stethoscope. Cardiac murmurs which are inaudible with any other stethoscope may be distinctly heard with this. Especially is this true of low-pitched murmurs due to aortic regurgitation. Yet it is useful for examination not merely of the heart, but of the lungs as well. For any one

who has difficulty in hearing the ordinary cardiac or respiratory sounds, or for one who is partially deaf, the instrument is invaluable. As the metal rim of the chest is apt to get unpleasantly cold, it is best to cover it with a bit of rubber or kid. This saves the patient some discomfort and also tends to prevent the instrument from slipping on the skin. The flat chest piece makes the instrument very useful in listening to the posterior portions of the lungs in cases of pneumonia in which the patient is too sick to be turned over or to sit up. Without moving the patient at all we can

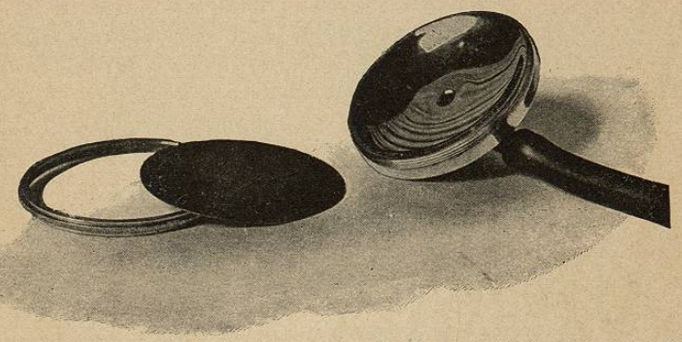

FIG. 87.—Chest Piece of Bowles' Stethoscope. On the right the shallow cup communicating with the ear tubes. On the left the diaphragm which covers the cup, and the ring which holds it in place.

work the chest piece in under the back of the patient by pressing down the bed-clothes, and in this way can listen to any part of the chest without moving the patient. A further advantage of the instrument is that it enables us to gain an approximately accurate idea of the heart sounds without undressing the patient. Respiratory sounds cannot well be listened to through the clothes, as the rubbing of the latter may simulate râles.

There are two purposes for which I have found the Bowles stethoscope inferior to the ordinary stethoscope:

(1) For listening over the apex of the lung for fine râles, *e.g.*, in incipient phthisis.

(2) For listening for *superficial* sounds, such as a friction rub or

a presystolic murmur.[1] When I desire to listen for fine râles at an apex, for a friction rub, or for a presystolic murmur, I separate the chest piece of the Bowles stethoscope from the hard-rubber bell into which it is inserted, thereby converting the instrument into one of the ordinary form. With an extra hard-rubber bell attached, the instrument is no more bulky than an ordinary stethoscope, and far more efficient. When used for listening to the respiration, the Bowles instrument gives us information similar in some respects to that obtained by the use of the free ear—that is, we are through it enabled to ascertain by listening at one spot the condition of a much larger area of the chest than can in any other way be investigated.

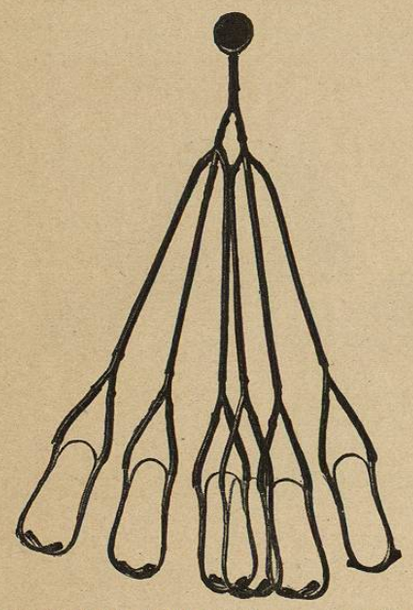

FIG. 88.—Bowles' Multiple Stethoscope for Six Students.

Owing to the fact that both cardiac and respiratory sounds are magnified by the Bowles stethoscope, this instrument is especially well adapted for use with some sort of an attachment whereby several sets of ear pieces are so joined by tubing to one chest piece that several persons may listen at once. Bowles' multiple stethoscope, fitted for six and for twelve observers, is seen in Figs. 88 and 89, and the method of its use in

[1] It has frequently been observed, when listening with the ordinary stethoscope, that a presystolic murmur can be better heard if only the very lightest pressure is made with the stethoscope. The fact that a thrill is communicated to the chest wall, and that that thrill is connected with the audible murmur explains my calling this murmur a superficial one.

Fig. 90. In the teaching of auscultation this instrument is of great value, saving as it does the time of the instructor and of the students and the strength of the patient. The sounds conducted through any one of the twelve tubes used in this instrument are as loud as those to be heard with a single instrument of the ordinary form, although far fainter than those to be heard with a single Bowles stethoscope.

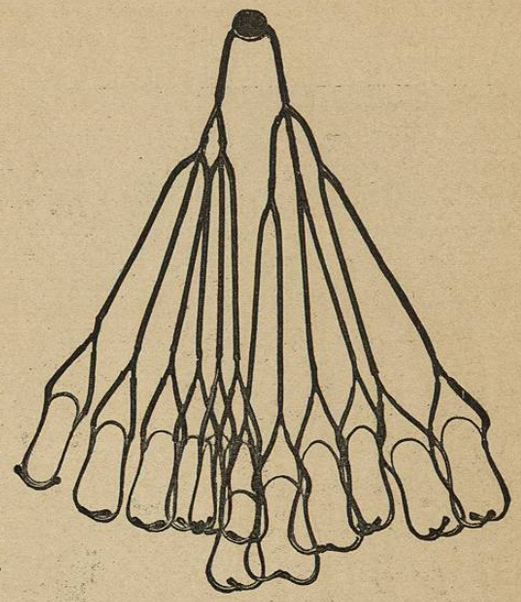

FIG. 89.—Bowles' Multiple Stethoscope for Twelve Students.

II. *The Use of the Stethoscope.*

Having secured an instrument which fits the ears satisfactorily, the beginner may get a good deal of practice by using it upon himself, especially upon his own heart. The chief point to be learned is to *disregard various irrelevant sounds* and to concentrate attention upon those which are relevant. Almost any one hears enough with a stethoscope, and most beginners hear too much. No great keenness of hearing is required, for the sounds which we listen for are not, as a rule, difficult to hear if attention is concentrated upon them.

A. Selective Attention and What to Disregard.

Accordingly, the art of using a stethoscope successfully depends upon the acquisition of two powers—

(*a*) A knowledge of what to disregard. (*b*) A selective atten-

tion or concentration upon those sounds which we know to be of importance.

Among the sounds which we must learn to disregard are the following:

(1) Noises produced in the room or its immediate neighborhood, but not connected with the patient himself. It is, of course, easier

FIG. 90.—Bowles' Multiple Stethoscope in Use. Twelve students listening at once.

to listen in a perfectly quiet room where there are no external noises which need to be excluded from attention, but as the greater part of the student's work must be done in more or less noisy places, it is for the beginner a practial necessity to learn to withdraw his attention from the various sounds which reach his ear from the street, from other parts of the building, or from the room

in which he is working. This is at first no easy matter, but can be accomplished with practice.

(2) When the power to disregard external noises has been acquired, a still further selection must be made among the sounds which come to the ear through the tubes of the stethoscope. Noises produced by friction of the chest piece of the stethoscope upon the skin are especially deceptive and may closely simulate a pleural or pericardial friction sound. It is well for the student to experiment upon the nature and extent of such "skin rubs" by deliberately moving the chest piece of the stethoscope upon the skin and listening to the sounds so produced. Mistakes can be avoided in the majority of cases by holding the chest piece of the stethoscope very firmly against the chest. This can be easily done when the patient is in the recumbent position, but when the patient is sitting up it may be necessary to press so hard with the chest piece of the stethoscope as to throw the patient off his balance unless he is in some way supported; accordingly, it is my practice in many cases to put the left arm around and behind the patient so as to form a support, against which he can lean when the chest piece of the stethoscope is pressed strongly against his chest. When listening to the back of the chest, the manœuvre is reversed. If the skin is very dry, the ribs are very prominent, or the chest is thickly covered with hair, it may be impossible to prevent the occurrence of adventitious sounds due to friction of the chest piece upon the chest, no matter how firmly the instrument is held. In case of doubt, and in any case in which a diagnosis of pleural or pericardial friction is in question, the surface of the chest, at the point where we desire to listen, should be moistened and any hair that may be present thoroughly wetted with a sponge, so that it will lie flat upon the chest. Otherwise the friction of the hair under the chest piece of the stethoscope may simulate crepitant râles as closely as "skin rubs" simulate pleural friction.

(3) The friction of the fingers of the auscultator upon the chest piece or on some other part of the stethoscope frequently gives rise to sounds closely resembling râles of one or another description. The nature of these sounds can be easily learned by intentionally moving the fingers upon the stethoscope. They are to be avoided

by grasping the instrument as firmly as possible, and by touching it with as few fingers as will suffice to hold it close against the chest.

(4) Noises produced by a shifting of the parts of the stethoscope upon each other are especially frequent in stethoscopes made in several pieces and jointed together. A variety of snapping and cracking sounds, not at all unlike certain varieties of râles, may thus be produced, and if we are not upon our guard, may lead to errors in diagnosis. Stethoscopes which have no hinges and which do not come apart are far less likely to trouble us in this way.

(5) When a rubber band is used to press the ear pieces more firmly into the ears, a very peculiar sound may be produced by the breathing of the auscultator as it strikes upon the rubber strap. It is a loud musical note, and may be confused with coarse, dry râles.

When one has learned to recognize and to disregard the noises produced in the ways above indicated, there is still one set of sounds which are very frequently heard, yet which have no significance for physical diagnosis, and must therefore be disregarded; I refer to

B. Muscle Sounds.

Patients who hold themselves very erect while being examined, or who for any reason contract the muscles of that portion of the chest over which we are listening, produce in these muscles a very peculiar and characteristic set of sounds. The contraction of any muscle in the body produces sounds similar in quality to those heard over the chest, but of less intensity.

Those who have the faculty of contracting the tensor tympani muscle at will can at any time listen to a typical muscle sound. Or close both ears with the fingers and strongly contract the masseter muscle, with the teeth clenched. A high-pitched muscle sound will be heard.

It is well also to have a patient contract one of the pectorals and then listen to the sound thus produced. In some cases a continuous, low-pitched roar or drumming is all that we hear ; in other cases we hear nothing but the breath sounds during expiration, while during inspiration the breath sound is obscured by a series of

short, dull, rumbling sounds, following each other at the rate of from five to ten in a second. Occasionally the sound is like the puffing of the engine attached to a pile-driver, or like a stream of water falling upon a sheet of metal just slowly enough to be separated into drops and heard at a considerable distance. As already mentioned, we are especially apt to hear these muscle sounds during forced inspiration, owing to the contraction of voluntary muscles during that portion of the respiratory act. They are most often heard over the upper portion of the chest (over the pectorals in front and over the trapezius behind), but in some persons no part of the chest is free from them. It is a curious fact that we are not always able to detect by sight or touch the muscular contractions which give rise to these sounds, and the patient himself may be wholly unaware of them. Under such circumstances they are not infrequently mistaken for râles, and I am inclined to think that many of the sounds recorded as "crumpling," "obscure," "muffled," "distant," or "indeterminate" râles are in reality due to muscular contractions. The adjectives "muffled" and "distant" give us an inkling as to the qualities which distinguish muscular sounds from râles. Râles are more clean cut, have a more distinct beginning and end, seem nearer to the ear, and possess more of a crackling or bubbling quality than muscle sounds.

I have made no attempt exhaustively to describe all the sounds due to muscular contractions and conducted to the ear by the stethoscope, but have intended simply to call attention to the importance of studying them carefully.

C. Other Sources of Error.

Another source of confusion, which for beginners is very troublesome, especially if they are using the ordinary form of stethoscope with a bell-shaped chest piece, arises in case the chest piece is not held perfectly in apposition with the skin. If, for example, the stethoscope is slightly tilted to one side so that the bell is lifted from the skin at some point, or if one endeavors to listen over a very uneven part of the chest on which the bell of the stethoscope cannot be made to rest closely, a roar of external noises reaches the

ear through the chink left between the chest piece and the chest. After a little practice one learns instantly to detect this condition of things and so to shift the position of the chest piece that external noises are totally excluded; but by the beginner, the peculiar babel of external noises which is heard whenever the stethoscope fails to fit closely against the chest is not easily recognized, and hence he tends to attribute some of these external sounds to diseased conditions within the chest.

Again, it is not until we have had considerable practice that

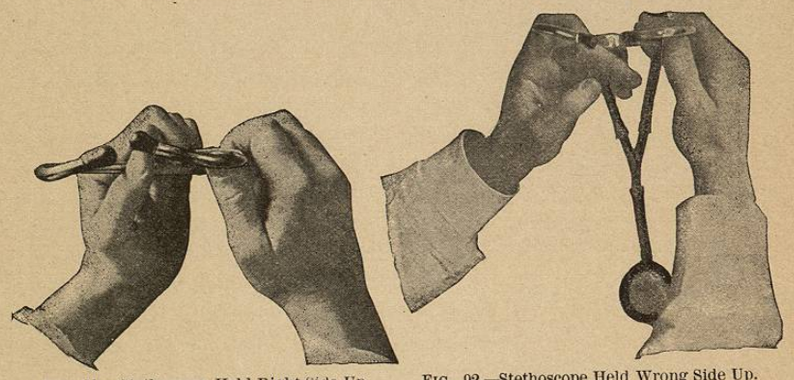

FIG. 91.—Stethoscope Held Right Side Up.

FIG. 92.—Stethoscope Held Wrong Side Up.

our sense of hearing comes instantly to tell us when something is wrong about the stethoscope itself; when, for example, one of the tubes is blocked, kinked, or disconnected, or when we are holding the stethoscope upside down, so that the ear pieces point downward instead of upward (see Figs. 91 and 92). It is only when we have learned through long practice about how much we ought to hear at a given point in the normal chest that we recognize at once the fact that we are not hearing *as much as we should*, in case some one of the above accidents has happened. Many beginners do not listen long enough in any one place, but move the chest piece of the stethoscope about rapidly from point to point, as they have seen experienced auscultators do; but it is remarkable how much more one can hear at a given point by simply persevering and

listening to beat after beat, or breath after breath. It is sometimes difficult to avoid the impression that the sounds themselves have grown louder as we continue to listen, especially if we are in any doubt as to what we hear. Therefore, if we hear indistinctly, it is important to keep on listening, and to fix the attention successively upon each of the different elements in the sounds under consideration. In difficult cases we should use every possible aid toward concentration of the attention, and where it is possible, all sources of distraction should be eliminated. Thus, in any case of doubt, I think it is important for the auscultator to get himself into as comfortable a position as he can, so that his attention is not distracted by his own physical discomforts. Many auscultators shut their eyes when listening in a difficult case so as to avoid the distraction of impressions coming through the sense of sight. It goes without saying that if quiet can be secured in the room where we are working, and outside it as well, we shall be enabled to listen much more profitably.

AUSCULTATION OF THE LUNGS.

In the majority of cases ordinary quiet breathing is not forcible enough to bring out the sounds on which we depend for the diagnosis of the condition of the lungs. Deep or forced breathing is what we need.

As a rule, the patient must be taught how to breathe deeply, which is best accomplished by personally demonstrating the act of deep breathing and then asking him to do the same. Two difficulties are encountered:

(*a*) The patient may blow out his breath forcibly and with a noise, since that is what he is used to doing whenever he takes a long breath under ordinary circumstances; or

(*b*) It may be that he cannot be made to take a deep breath at all. The first of these mistakes alters the sounds to be heard with the stethoscope in any part of the chest by disturbing both the rhythm and the pitch of the respiratory sounds In this way the breathing may be made to sound tubular or asthmatic throughout a sound chest. This difficulty can sometimes be overcome by demonstrating to the patient that what you desire is to have him take a