CHAPTER V.

PALPATION AND THE STUDY OF THE PULSE.

I Palpation.

The most important points to be determined by palpation—that is, by laying the hand upon the surface of the chest—are:

(1) The position and character of the *apex beat* of the heart.

(2) The presence of a "*thrill*" (see below).

(3) The vibrations of the spoken voice ("*tactile fremitus*").

(4) The presence of pleuritic or pericardial *friction*.

Other less important data furnished by palpation will be mentioned later.

(1) *The Apex Beat.*

(*a*) In feeling for the apex impulse of the heart, one should first lay the palm of the hand lightly upon the chest just below the left nipple. In this way we can appreciate a good deal about the movements of the heart, and confirm or modify what we have learned by inspection. One learns, in the first place, whether the heart beat is *regular* or not, and in case it is irregular, whether the beats are unequal in force or whether some are skipped; further, one gets a more accurate idea than can be obtained through inspection regarding the *character of the cardiac movements*. The powerful heaving impulse suggesting a hypertrophied heart, the diffuse slap often felt in dilatation of the right ventricle, the sudden tap characteristic of mitral stenosis, the deliberate thrust occasionally met with in aortic stenosis, may be thus appreciated.

(*b*) After this, it is best to lay the tips of two or three fingers over the point where the maximum impulse is to be seen, and follow it outward and downward until one arrives at the point farthest to the left and farthest down at which it is still possible to feel

any up-and-down movement. This point usually corresponds with the apex of the heart, as determined by percussion. *It does not correspond with the maximum cardiac impulse*, but is often to be found at least an inch farther to the left and downward (see above, Fig. 58).

Sometimes one can localize by palpation a cardiac impulse which is not visible; on the other hand, in some cases we can see pulsations that we cannot feel. Both methods must be used in every case.

The results obtained by palpation and inspection of the apex region give us the most reliable data that we have regarding the size of the heart. Percussion may be interfered with by the presence of gas in the stomach, of fluid or adhesions in the pleural cavity, or by the ineptness of the observer, but it is almost always possible with a little care to make out by a combination of palpation and inspection the position of the apex of the heart. When we can neither feel it nor see it, we may have to fall back upon auscultation, considering the apex of the heart to be at or near the point at which the heart sounds are heard loudest. When endeavoring to find the apex of the heart, we must not forget that the position of the patient influences considerably the relation of the heart to the chest walls. If the patient is leaning toward the left or lying on the left side, the apex will swing out several centimetres toward the left axilla.

(2) "*Thrills.*"

When feeling for the cardiac impulse with the palm of the hand, we are in a good position to notice the presence or absence of a very important physical sign to which we give the name of "*thrill.*" The feeling imparted to the fingers by the throat of a purring cat is very much like the palpable "*thrill*" over the precordia in certain diseases of the heart to be mentioned later. It is a vibration of the chest wall, usually confined to a small area in the region of the apex impulse, but sometimes felt in the second right intercostal space or elsewhere in the precordial region. This vibration or thrill almost always occurs intermittently, *i.e.*, only during

a portion of the cardiac cycle. When felt in the apex region, it usually occurs just before the cardiac impulse; this fact we express by calling it a "*presystolic thrill*"; but occasionally we may feel a *systolic* thrill at the apex—one, that is, which accompanies the cardiac impulse. The word *thrill* should be used to denote only a purring, vibrating sensation communicated to the fingers by the chest wall. It is incorrect to speak of a thrill as if it were something audible.

We must also distinguish a purring thrill from the slight shudder or jarring which often accompanies the cardiac impulse in functional neuroses of the heart or in conditions of mental excitement.

As a rule we can appreciate a thrill more easily if we lay the fingers very lightly upon the chest, using as little pressure as possible. Firm pressure may prevent the occurrence of the vibrations which we desire to investigate. Of the thrills felt over the base of the heart, more will be said in Chapter X.

(3) *Vibrations Communicated to the Chest Wall by the Voice.*

"*Tactile fremitus*" is the name given to the sense of vibration communicated to the hand if the latter is laid upon the chest while the patient repeats some short phrase of words. The classical method of testing tactile fremitus is to ask the patient to count "one, two, three," or to repeat the words "ninety-nine" while the palm of the hand is laid flat upon the chest. The amount of fremitus to be obtained over a given part of the thorax varies, of course, according to the loudness of the words spoken, and is influenced also by the vowels contained in them. A certain uniformity is obtained by getting the patient to repeat always the same formula. Thus, he is likely to use the same amount of force each time he repeats them and to use approximately the same pitch of voice.

Other things being equal, the fremitus is greater in men than in women, in adults than in children, and is more marked in those whose voices are low pitched than in those whose voices are relatively shrill. The amount of fremitus also varies widely in different parts of the healthy chest A glance at Fig 64 will help us to realize this The parts shaded darkest communicate to the fingers

the most marked fremitus, while in the parts not shaded at all, little or no fremitus is felt. Intermediate degrees of vibration are represented by intermediate tints of shading. From this diagram we see at once (*a*) that the maximum of fremitus is to be obtained over the apex of the right lung in front, (*b*) that it is greater in the upper part of the chest than in the lower, and somewhat greater throughout the right chest than in corresponding parts of the left.

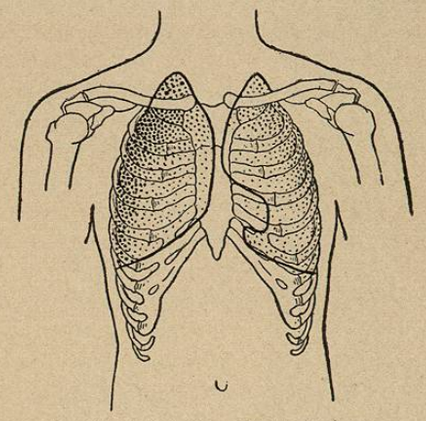

FIG. 64.—Distribution of Tactile Fremitus.

This natural inequality of the two sides of the chest cannot be too strongly emphasized.

Comparatively little fremitus is to be felt over the scapulæ behind, and still less in the precordial region in front. The outlines of the lungs can be quite accurately mapped out by means of the tactile fremitus in adults of low-pitched voice. In children, as has been already mentioned, fremitus is usually very slight and may be entirely absent, and in many women it is too slight to be of any considerable diagnostic value. Again, some very fat persons and those with thick chest walls transmit but little vibration to their chest walls when they speak. On the other hand, in emaciated patients or in those with thin-walled, flexible chests, the amount of fremitus is relatively great.

Bearing in mind all these disparities—disparities both between persons of different age and different sex, and between the two sides of the chest in any one person—we are in a position to appreciate the modifications to which disease gives rise and which may be of great importance in diagnosis. These variations are:

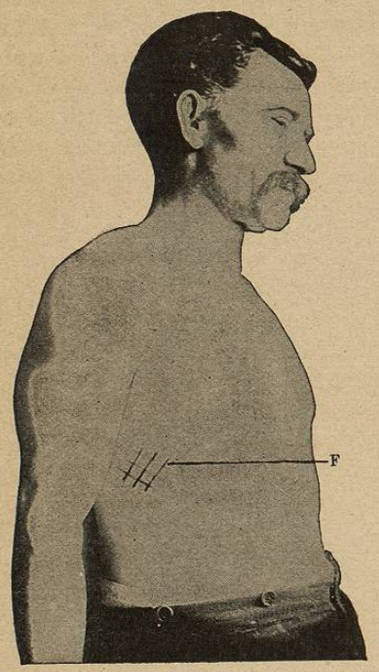

FIG. 65.—Showing Point (F) at Which Pleural Friction is Most Often Heard.

(*a*) Diminution or absence of fremitus.

(*b*) Increase or absence of fremitus.

(*a*) If the lung is pushed away from the chest wall by the presence of air or fluid or tumor in the pleural cavity, we get a diminution or absence of tactile fremitus—diminution where the layer of fluid or air is very thin, absence where it is of considerable thickness.

(*b*) Solidification of the lung due to phthisis or pneumonia is the commonest cause of an *increase* in tactile fremitus. Further details as to the variations in amount of fremitus in different diseases may be found in later chapters of this book.

(4) *Friction, Pleural or Pericardial.*

In many cases of inflammatory roughening of the pleural surfaces ("dry pleurisy") a grating or rubbing of the two surfaces upon each other may be felt as well as heard during the movements of respiration, and especially at the end of inspiration. Such friction is most often felt at the bottom of the axilla, on one side or

the other, where the diaphragmatic pleura is in close apposition with the costal layer (see Fig. 65, p. 100).

Similarly, in roughening of the pericardial surfaces ("dry" or "plastic" pericarditis) it is occasionally possible to feel a grating or rubbing in the precordial region more or less synchronous with the heart's movements. Such friction is most often to be felt in the region of the fourth left costal cartilage (see Fig. 66).

Palpable friction is of great value in diagnosis because it is a sign about which we can feel no doubt; as such it frequently con-

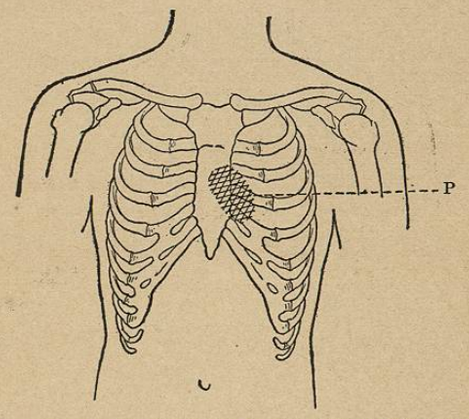

FIG. 66.—Showing Point (P) at Which Pericardial Friction is Most Often Heard.

firms our judgment in cases in which the auscultatory signs are less clear. Friction sounds heard with the stethoscope may be closely simulated by the rubbing of the stethoscope upon the skin, but palpable friction is simulated by nothing else, unless occasionally by

(5) *Palpable Râles.*

Occasionally coarse, dry râles communicate a sensation to the hand placed upon the chest in the region beneath which the râles are produced; to the practised hand this sensation is quite different from that produced by pleural friction, although the difference is hard to describe.

(6) Tender points upon the thorax.

In intercostal neuralgia, dry pleurisy, necrosis of a rib, and sometimes in phthisis, one finds areas of marked tenderness in different parts of the chest. The position of the tender points in intercostal neuralgia generally corresponds with the point of exit of the intercostal nerves. These points are shown in Fig. 67.

The tenderness in phthisis is most apt to be in the upper and front portions of the chest. In neurotic individuals we sometimes find a very superficial tenderness over parts of the thorax; in such

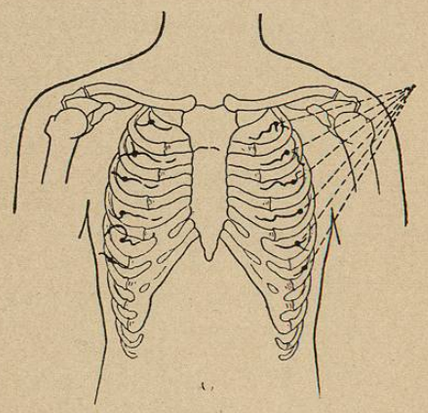

FIG. 67.—Showing Points of Exit of the Intercostal Nerves.

cases pain is produced by very light pressure, but not by firm pressure at the same point.

(7) The presence of pulsations in parts of the chest where normally there should be none is suggested by inspection and confirmed by palpation. It is not necessary to repeat what was said above as to the commonest causes of such abnormal pulsations. When searching for slight, deep-seated pulsation (*e.g.*, from an aortic aneurism), it is well to use bimanual palpation, keeping one hand on the front of the chest and the other over a corresponding area in the back.

(8) Fluctuation or elasticity in any tumor or projection from

the chest is a very important piece of information which palpation may give us.

(9) The temperature and quality of the skin are often brought to our attention during palpation. After a little practice one can usually judge the temperature within a degree or two simply from the feeling of the skin. Any roughness, dryness, or loss of elasticity of the skin (myxœdema, diabetes, long-standing pyrexia, or wasting disease) is easily appreciated as we pass the hand over the surface of the thorax or down the arms. The same manipulation often brings to our attention in cases of alcoholism an unusually smooth and satiny quality of the cutaneous surface.

II. The Pulse.

Fifty years ago the study of the pulse furnished the physician with most of the available evidence regarding the condition of the heart. At present this is not the case. With the increase of our knowledge of the direct physical examination of the heart and of the various methods of measuring the systolic or diastolic pressure on the peripheral arteries, the amount of information furnished exclusively by the pulse has proportionately decreased, until today, I think, it is a fact that there is but little to be learned by studying the pulse which could not be as well or better ascertained by examining the heart and measuring the arterial pressure.

Nevertheless, the radial pulse is still an important factor in diagnosis, prognosis, and treatment, and will remain so, because it gives us quickly, succinctly, and in almost every case a great deal of valuable information which it would take more time and trouble to obtain in any other way. As we feel the pulse, we get at once a fact of central importance in the case; by the pulse the steps of our subsequent examination are guided. In emergencies or accidents the pulse gives us our bearings and tells us whether or not the patient's condition is one demanding immediate succor—*e.g.*, hypodermic stimulation—and whether the outlook is bright or dark. To gather this same information in any other way would involve losing valuable time.

Again, when one has to to see a large number of patients in a

short time, as in visiting a hospital ward or on the crowded days of private practice, the pulse is an invaluable short cut to some of the most important data.

Moreover, there are some important inferences which the pulse and *only the pulse* enables us to make. They are not numerous, but their value may be great. Delay in one radial pulse when taken in connection with other signs may furnish decisive evidence of aneurism of the aortic arch; aortic stenosis is a lesion which cannot be diagnosed unless the pulse shows certain characteristic features; arterial degeneration may betray its presence chiefly in the peripheral arteries.

Since, then, the condition of the pulse furnishes information of crucial importance in a few diseases, and is a quick, reliable, and convenient indication of the general condition of the circulation in all cases, it is essential that we should study it most carefully both in health and in disease.

How to Feel the Pulse.

(*a*) We usually feel for the pulse in the radial artery because this is the most superficial vessel which is readily available. Occasionally, as when the wrists are swathed in surgical dressings or tied up in a straight-jacket, we make use of the temporal, facial, or carotid arteries.

(*b*) Both radials should always be felt at the same time. By making this a routine practice many mistakes are avoided and any difference in the two pulses is appreciated.

(*c*) The tips of three fingers (never the thumb) should be laid upon the artery, and the following points noted:

1. The *rate* of the pulse.
2. The *rhythm* of the pulse (regular or irregular).
3. The amount of force necessary to obliterate it (*compressibility*).
4. The *size and shape of the pulse wave.*
5. The extent to which the artery collapses between beats (*tension*).
6. The *size and position of the artery.*

7. The condition of the *artery walls.*

Each of these points will now be considered in detail.

1. The Rate of the Pulse.

In the adult male the pulse averages 72 to the minute, in the female 80. In children it is considerably more frequent. At birth it averages about 130, and until the third year it is usually above 100. In some families as low pulse, 60 or less, is hereditary; on the other hand, it is not very rare to observe a permanent pulse rate of 100 or more in a normal adult (see below, p. 261). Exercise or emotion quickens the pulse very markedly, and after food it is somewhat accelerated. Some account of the causes of pathological quickening or slowing of the pulse will be found on pages 261 and 262.

2. Rhythm.

The pulse may be irregular in *force*, in *rhythm*, or (as most commonly happens) in both respects. As a rule, irregularities in force are the more serious. Intermittence or irregularity in rhythm *alone*, means that the heart skips one or more beats at regular or irregular intervals. This may be a mere idiosyncrasy not associated with any evidence of disease. I have known several instances in which a perfectly sound person has been aware of such an irregularity throughout life—the heart dropping regularly every third or fourth beat. Such rhythmical intermittence in health is not uncommon.

When beats are dropped, not at fixed intervals, but *irregularly*, the pulse waves usually vary in *force* as well. This combination of irregular cardiac rhythm with variations in the strength of the individual beats is very rarely seen in health and usually points to functional or structural disease of the heart.

Special types of irregularity will be discussed later.

In general it may be said (*a*) that irregularity in the force of the pulse beats is a serious sign, if overexertion and temporary toxic influences (tobacco, tea, etc.) can be ruled out; (*b*) that it is far more serious when occurring in connection with diseases of the

aortic valve than in mitral disease; and (*c*) that it often occurs in connection with sclerosis of the coronary arteries and myocarditis.

3. Compressibility, or Systolic Arterial Pressure.

There is no single datum concerning the pulse more important than the amount of force needed to obliterate its beat. Until recently we have had no more accurate method of measuring the systolic blood pressure than the following: Let the tips of three fingers rest as usual on the radial artery. Then gradually increase the pressure made upon the vessel with the finger nearest the patient's heart until the pulse wave is arrested and cannot be felt by the other fingers which rest loosely on the artery. The degree of force necessary to arrest the wave varies a great deal in different cases and at different times of day, but by trying the above manœuvre day after day in as many cases as possible, and especially by comparing one's impressions with accurate measurements of blood pressure (*vide infra*), one comes to possess a fairly accurate mental standard or picture of the compressibility of the average pulse, and is then able to estimate in any given case whether it is more or less compressible than usual.

The compressibility of the pulse is a rough measure of the muscular power of the heart's beat, and therefore gives us direct information about this important element in the patient's condition.

4. The Size and Shape of the Pulse Wave.

Of the use of the sphygmograph for representing pulse waves I shall speak later. The points discussed in this section are appreciable to the fingers.

I. The size of the pulse wave—the height to which it lifts the finger—depends on two factors:

(*a*) The force of the cardiac contractions (systolic arterial pressure).

(*b*) The tightness or looseness of the artery (*tension*, or diastolic pressure).

If the arteries are contracted and small, the pulse wave corresponds, while if they are large and relaxed, it needs only a moderate degree of power in the heart to produce a high pulse wave. If the tension remains constant the size of the pulse wave depends on the force of the heart's contraction. If the heart power remains constant, the size of the pulse wave depends on the degree of vascular tension. Vascular tension is estimated in ways to be described presently, and after allowing for it, we are enabled to estimate the power of the heart's contractions from the height of the pulse wave.

II. The *shape of the pulse wave* is also of importance.

(*a*) It may have a very sharp summit, rising and falling back again suddenly; this is known as an *ill-sustained* pulse, and may be due to a lack of sustained propulsive power in the contracting heart muscle, to low vascular tension, or to a combination of the two causes. A weak heart with low arterial tension often produces such a pulse wave—deceptively high and giving at first an impression of power in the heart wall, but ill sustained and easily compressible. This is the "bounding pulse" of early infectious processes. An exaggeration of this type of pulse is to be felt in aortic regurgitation (see page 232).

(*b*) In sharp contrast with the above is the pulse wave which lifts the finger gradually and slowly, sustains it for a relatively long period, and then sinks gradually down again. Such a pulse with a "long plateau" instead of a sharp peak is to be felt most distinctly in aortic stenosis, less often in mitral stenosis and other conditions (see page 242).

(*c*) The *dicrotic* pulse wave is one in which the secondary wave, which the sphygmograph shows to be present in the normal pulse, is much exaggerated, so that a distinct "echo" of the primary wave is felt after each beat. If the heart is acting rapidly, this dicrotic wave does not have time to fall before it is interrupted by the primary wave of the next beat, and so appears in the sphygmographic tracing as a part of the up-stroke of the primary wave. This is known as the "*anacrotic* pulse."

(*d*) The shape of the *high-tension pulse wave* will be described in the next paragraph.

5. *Tension, or Diastolic Arterial Pressure.*

The degree of contraction of the vascular muscles determines the size of the artery and (to a great extent) the tension of the blood within it. But if the heart is acting feebly, there may be so little blood in the arteries that even when tightly contracted they do not subject the blood within them to any considerable degree of tension. To produce high tension, then, we need two factors: a

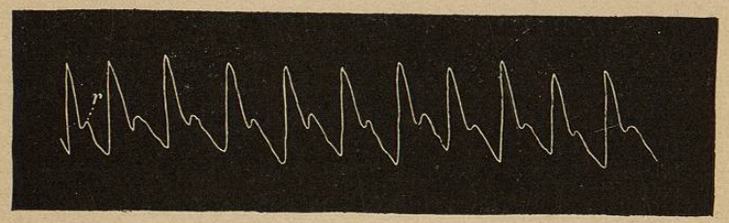

FIG. 68.—Sphygmographic Tracing of Low Tension Pulse.

certain degree of power in the heart muscle, and contracted arteries. To produce low tension we need only relaxation of the arteries, and the heart may be either strong or weak.

The pulse of low tension collapses between beats, so that the artery is less palpable than usual or cannot be felt at all. Normally,

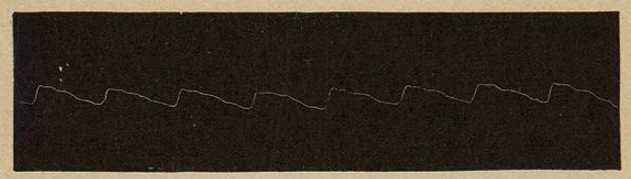

FIG. 69.—Sphygmographic Tracing of High Tension Pulse.

the artery can just be made out between beats, and any considerable lowering of arterial tension makes it altogether impalpable except during the period of the primary wave and of the dicrotic wave, which is often very well marked in pulses of low tension. The shape of the wave under these conditions has already been described (see Fig. 68).

The pulse of high tension is perceptible between beats as a *distinct cord which can be rolled between the fingers*, like one of the tendons of the wrist. It is also difficult to compress in most cases, but this may depend rather on the heart's power than on the degree of vascular tension. A high-tension pulse is often indistinguishable from one stiffened by arteriosclerosis (*vide infra*). The pulse wave is usually of moderate height or low, and falls away slowly with little or no dicrotic wave (see Fig. 69).

6. *The Size and Position of the Artery.*

I have often known errors to occur because a small *artery* is mistaken for a small *pulse wave*. The size of the branches of the arterial tree varies a great deal in different individuals of the same weight and height, and if the radial is unusually small and a hurried observation gives us the impression (true, so far as it goes) that there is very little in the way of a pulse to be felt, we are apt to conclude (wrongly, perhaps) that the heart's work is not being properly performed. The effort to obliterate such a pulse, however, *may* set us right by showing that despite the small size of the vessel (and consequently of the pulse wave) it takes as much force as it normally does to obliterate it. But in many cases we can determine the question satisfactorily often by using some instrument for measuring arterial pressure. Thus, a *small pulse wave* (in a congenitally small artery) may be distinguished from a *weak pulse*. From the *contracted* artery of high vascular tension we distinguish the *congenitally small* artery because the latter is not to be rolled beneath the fingers, and is not more than normally palpable between the pulse beats.

Not infrequently the nurse reports in alarm that the patient has no pulse, when in reality the pulse is excellent but the artery misplaced so as to be impalpable in the ordinary situation. It may be simply more deeply set than normal, so that the fingers cannot get at it, or it may run superficially over the end of the radius toward the "anatomical snuff box." Other anomalies are less common. As a rule, the other radial artery is normally placed and can be used