PALPATION OF THE PRÆCORDIAL REGION.

The investigation (by means of palpation) of the phenomena which depend for their existence on the action of the heart, and which manifest themselves in the prækordial region and the parts in its vicinity, is in many respects supplementary to inspection, the results already acquired by the latter method being completed and rendered more intelligible by those obtained by the former, though palpation alone is also capable of affording very important information. Very frequently palpation and inspection are employed simultaneously, a fact the practical bearing of which has been repeatedly pointed out while discussing the signs observed in inspection.

The phenomena to which examination by palpation is usually directed are: the *cardiac impulse*, its force and extent; *pulsations* appearing at various points on the surface of the thorax, and connected directly or indirectly with the impulse of the heart; *murmurs* which communicate a certain feeling of vibration to the *hand* in the prækordial region; the *arterial pulse*.

Palpation of the *impulse of the heart* yields substantially the same indications as inspection, but with more rigorous exactness, particularly as regards its situation, extent, and force. Slight increase of the energy with which the heart contracts, an impulse of a heaving character, extension of the area of impulse towards the right, &c., are conditions the presence of which can often be determined with certainty only by the aid of palpation.

Murmurs associated with tactile vibration are occasionally felt in the prækordial region, coincident with the heart's contraction (systolic), going immediately before it (presystolic), following closely after it (diastolic), or occurring irregularly in the pause. Systolic, diastolic, and presystolic thrills of this kind originate *within* the heart or at the root of the great vessels, while those observed in the interval between the contractions of the heart arise in parts *external* to that organ; the former are termed *endocardial* thrills, the latter exocardial, or, as they are generated within the pericardium, *pericardial* thrills.

Endocardial Thrill.

Endocardial thrill gives to the hand the impression of light rubbing or vibration, a sensation which so resembles the purring of a cat that Lænnec bestowed on it the name *fremissement cataire*. It is set up when the blood-stream during the systole or diastole or (rarely) during both phases of the heart's action, is thrown into vibration, acquiring a whirling motion, from contact with degenerated *valves*, or at contracted valvular orifices, or in pathological dilatation of the *initial portions of the great vessels. This vibration, which is felt as a thrill, is also audible as a murmur;* but every such disturbance within the organs of circulation is not sufficiently great to make itself sensible externally to palpation, only a comparatively small proportion of audible murmurs being associated with tactile vibration. Endocardial thrill usually increases in intensity as the heart's action becomes more energetic, or may even in that way be first called into existence.

1. Systolic Thrill.

This may be developed at the mitral, tricuspid, aortic, or pulmonary orifice. It is either most marked at the point at which it originates, provided there be no obstacle to its transmission to the surface at that situation,—as when the heart is covered by lung,—or it is propagated most distinctly in the direction of the current of the blood.

Purring tremor, systolic in rhythm, felt most intensely at the apex and becoming feebler the further the hand is removed from that part, either to the right or upwards, is invariably due to insufficiency of the mitral valve. Immediately over the valve itself (at the sternal insertion of the third rib, in the second left intercostal space) it is not appreciable, the base of the heart being there sheltered behind a process of lung tissue.

Systolic vibration in insufficiency of the mitral valve is nevertheless far from common, occurring, according to my observations, which include nearly 200 instances of this valvular lesion, in little more than a fifth of the cases; it may be wanting even though the accompanying murmur be loud and harsh.

Systolic fremissement most perceptible at the lower end of the sternum is generally transmitted from the aortic orifice, or is

caused, in very rare cases, by incompetency of the tricuspid valve.

Such a thrill is to be referred to incompetency of the tricuspid valve only when associated with pulsation of the jugular veins. In four cases of tricuspid insufficiency which came under my notice there was no trace of vibration of this kind.—Most commonly it is *propagated* from the aortic orifice, in cases of stenosis or atheromatous degeneration of the vessel, and in these circumstances is diffused over a large part of the sternum and the adjoining costal cartilages.

A systolic thrill *confined* to a spot in the second left intercostal space, near the sternum, may arise from roughness or contraction of the pulmonary orifice, both very rare valvular affections; it may also be due to mitral insufficiency, when, for instance, the base of the heart lies in immediate contact with the chest-wall, from retraction of the anterior margin of the left lung.

Systolic *fremissement* in the second right intercostal space, close to the sternum, radiating along the body of the bone even to the ensiform process and to the adjacent insertions of the ribs on the right side, proceeds from roughness or contraction of the aortic orifice, from atheromatous degeneration of the aortic walls, and from aneurisms of the ascending aorta.

2. Diastolic Thrill.

Diastolic thrill most frequently takes its rise at the mitral orifice, more rarely at the aortic orifice, still more seldom at the pulmonary orifice, and is scarcely ever dependent on uncomplicated disorder of the tricuspid orifice.

Constriction of the *mitral orifice* produces a diastolic thrill, the current of blood being agitated or thrown into eddies in passing from the left auricle into the left ventricle. This tremulous sensation is felt most distinctly at the apex of the heart, is usually spread over a somewhat large area, but is not at all points of equal intensity. It exists in every case of *considerable* stenosis of the left auriculo-ventricular orifice, or, if it be wanting, may usually be developed by whatever tends to increase the heart's action,—raising the arms rapidly, or walking quickly to and fro, &c. It lasts either throughout the whole of the diastole, or appears only at the end of it, shortly before the systole, and is therefore sometimes also called *presystolic* thrill. If it be prolonged through the whole diastole to the next systole it is generally feebler at its commencement; at the end of the diastole, that is in the presystole, it is suddenly much augmented in intensity by the contraction of the auricle, which presses the blood with greater force through the narrow mitral orifice. Such cases are usually also characterised by a loud murmur, quite perceptible to the hand, but still more so to the ear, similarly divided into two stages or portions (see Mitral Murmurs).

The diastolic thrill generated at the *aortic orifice* does not, like that originating at the mitral orifice, show the jerking quality just mentioned, but is continuous, of nearly equal intensity during the whole of the diastole. It occurs, though not very frequently, in insufficiency of the aortic valves, and is owing to the regurgitation of blood from the aorta into the left ventricle. It may usually be felt over the whole of the sternum, but is most fully developed at that part behind which the aortic orifice really lies. *Fremissement* of this description, radiating to some distance over the sternum and further also to the left or right, appears not only in aortic insufficiency but also as one of the signs of large aortic aneurisms.

Diastolic thrill from valvular lesion at the orifices of the *right* heart is exceedingly rare.

Diastolic thrill over the *pulmonary orifice* is connected with incompetency of the pulmonary valves; it manifests itself in the second left intercostal space at the sternal insertion of the third rib, and is limited to a comparatively small area.

On only one occasion have I felt a diastolic thrill clearly traceable to pulmonary insufficiency. Its situation, and the point at which it is of maximum intensity, effectually guard against its being confounded with a thrill from any other source. Such a mistake is possible only in those comparatively rare cases of mitral stenosis in which the left auricle, being exposed by the retraction of the anterior border of the left lung, comes into close contact with the thoracic parietes, when a similar thrill is noticed also in the second left intercostal space. In these circumstances, however, the tremor is strongest at the apex of the heart, and is further diffused over a much larger surface than the vibration due simply to pulmonary insufficiency.

Diastolic thrill originating at the *tricuspid orifice* is always the result of stenosis. This lesion is one of the rarest in the whole range of heart affections, and almost never occurs without complication.

Pericardial Thrill.

Pericardial friction-sound is frequently accompanied by a thrill, produced by the movements of the heart, the visceral and parietal layers of the pericardium, roughened by inflammatory fibrinous deposit, being thereby caused to rub on each other.—As this sign is better appreciable by the ear than by the hand, it is reserved for discussion in the chapter on Auscultation.

Pulsations of the Large Vessels.

Palpation also proves useful in the investigation of certain circumscribed pulsations observed at various points on the anterior surface of the chest, and dependent on the movements of the great vessels, the aorta and subclavian artery. The causes of these pulsations (undue expansion of the vessels from hypertrophy of the left ventricle, or *aneurismal* dilatation of the aorta) have already been under consideration on p. 220, in the section devoted to Inspection.

Palpation elucidates their nature more fully and exactly than Inspection, particularly with regard to the area they involve, their force, and the presence or absence of thrill.

From the pulsations just mentioned, due to dilatation of the arteries and synchronous with the systole of the heart, certain others are to be distinguished, *diastolic* in rhythm, and confined to a small part of the great vessels close to their origin. There is thus sometimes seen and felt in the *second left* intercostal space close to the sternum a strictly circumscribed pulsation, appearing an instant later than the heart's impulse, that is, in the diastole; in very marked cases this alternate elevation of the tissues over the apex and those in the second intercostal space is well brought out by lightly placing a finger on each of the spots indicated. This short *diastolic* stroke proceeds from the pulmonary artery, and is connected with *hypertrophy of the right ventricle;* it is the expression of the *unduly forcible closure of the pulmonary valves*, from the abnormally energetic recoil of the blood within the vessel. The conveyance of this impulse to the chest-wall is favoured by conditions in which the rigidity of the thorax is diminished (it is therefore most perfect in children), and

by *retraction of the anterior border of the left lung*, such as results from hypertrophy of the right ventricle, when no lung-tissue is interposed between the pulmonary artery and the thoracic parietes. Where there is no retraction of the lung the diastolic impulse of the pulmonary artery is exceedingly feeble or absolutely wanting; it disappears also at a later stage when the contractile power of the right ventricle is lessened by fatty degeneration of the muscular substance of the heart. Inasmuch as the pulsation in question can be set up only by a very considerable degree of hypertrophy of the right ventricle, and as such enlargement results only from defects of the mitral valve, a diastolic impulse plainly emanating from the pulmonary valves may be looked upon as an almost certain sign of mitral insufficiency or stenosis of the left auriculo-ventricular orifice.—This phenomenon presents itself also to the ear in the greater loudness of the pulmonary arterial sound.

More rarely a *diastolic impulse* is felt in the *second right* intercostal space, close to the sternum. It comes from the aorta, and is occasioned by the *abnormally forcible closure of the aortic valve, observed in hypertrophy of the left ventricle.* Its rarity is due to the fact that the conditions which give rise most frequently to hypertrophy of the left heart are precisely those in which the aortic valve is more or less diseased and incompetent; this form of pulsation therefore is limited to those cases of enlargement of the left ventricle which, unattended by aortic valvular lesion, depend on contraction of the kidneys or sclerosis of the arteries, though even in such circumstances the symptom is seldom met with, as the heart is not always sufficiently hypertrophied, nor does the aorta approach close enough to the chest-wall, to ensure the ready transmission of the diastolic valvular impulse.

Examination of the Arterial Pulse.

The pulse is always taken at the radial artery, or at the carotid or other superficial arteries (the brachial or femoral) for the sake of comparison.

1. Frequency of the Pulse.

The acceleration of the pulse in all febrile conditions has already been referred to (p. 8). In diseases of the heart the

frequency of the pulse is most commonly increased, seldom normal or diminished. It is invariably increased in the acute affections of the heart (endocarditis, myocarditis, pericarditis), very generally (among the chronic diseases of the heart) by valvular lesions, and in all those disorders grouped together under the term cardiac neuroses.

The rate of the pulse in the chronic, apyrexial diseases of the heart (valvular lesions) varies from 80—120 beats per minute, the higher numbers being reached only occasionally, when the heart is stimulated to greater activity by physical exertion. The pulse of mitral lesion often differs very markedly, with respect to frequency, from that of aortic disease: in the former it is almost always rapid, in the latter it may be scarcely altered, normal, or even (as in cases of constriction of the aortic orifice) sub-normal. A slow pulse sometimes accompanies atheroma of the aorta, probably from mechanical irritation of the cardiac branches of the vagus.—Patients suffering from idiopathic fatty disease of the heart, also, have usually a remarkably slow pulse, (in two such cases noted by me it fell, in the one to 28, in the other to 22, per minute), though in some instances it is normal or even accelerated. The pulse may further be very strikingly retarded, numbering 18 or even fewer beats per minute, without any disease of the heart being objectively recognisable; causes located in the nervous centres may then be suspected, and now and then actually demonstrated.

2. Rhythm of the Pulse.

In health the strokes of the pulse follow each other at perfectly regular intervals, that is to say, the heart is rhythmical in action. This rhythm, however, is subject to very frequent disturbance: in the minor degrees of irregularity the arhythmical contractions of the heart are few and occur at variable points in a moderately long succession of rhythmical contractions; in the severer forms the pulse loses all trace of regularity, and its individual beats very generally become unequal in volume and force.—Absence of rhythm may appear in the course of the most widely different diseases, as the expression of a derangement of the innervation of the heart; slighter deviations in this direction are also witnessed in physiological conditions, especially in advanced old age, and transiently under psychical influences. The greatest amount of irregularity is found in cases of cardiac disease, particularly of valvular affections, and of these it is most frequently attendant on mitral lesion. Irregularity of the pulse is most commonly first developed in heart diseases at a rather advanced stage, when the

compensatory structural changes fail to answer their purpose, the only exception to this rule being stenosis of the left auriculo-ventricular orifice, in which this symptom may make its appearance while compensation is still perfect.

An artificial and temporary disturbance of the rhythm of the pulse may be excited, in cardiac diseases, by the use of digitalis.

A peculiar variety of irregularity of the pulse has been described by Traube, under the designation *pulsus bigeminus*. This consists of a pulse in which the beats run in pairs, a somewhat protracted pause occurring regularly between every two pulsations, that is, between every two contractions of the heart. The cause of the bigeminate pulse has not yet been satisfactorily made out. This and other modifications of the rhythm of the pulse are sometimes discovered in animals in which the intracardiac blood-pressure is augmented. In men it is associated almost exclusively with the existence of some obstruction to the circulation (valvular defects, &c.).—Instances of pulsus *trigeminus*, in which every third beat is followed by a pause, have been put on record by Riegel, Rosenstein, and others.—A further variation of the bigeminate pulse is presented in the pulsus *alternans*, which is characterised by the regular alternation of a small feeble pulsation with one which is larger and stronger (Traube). Like the pulsus bigeminus it appears, according to Schreiber, in a great variety of conditions, relatively most frequently in cases of mitral lesion. Occasionally the second of the two beats becomes so feeble as to be no longer recognisable by the finger, notwithstanding the fact that both contractions of the heart are still distinctly appreciable to palpation in the præcordial region; there is but *one* pulsation at the wrist, therefore, to represent every two contractions (Fräntzel), the second of which is thus *abortive*.—The irregularities of pulse just named merge readily into each other, each form then lasting for a variable period. Arhythmical action of the heart, particularly that which depends on the administration of digitalis or on mitral stenosis, is often for a short time accompanied by a pulse having the characters of the pulsus bigeminus or the pulsus alternans, but it is very seldom that these phenomena are repeated for any length of time with such a degree of constancy that the irregularity becomes really rhythmical in its recurrence.—Another and somewhat rare variety of pulse has been described, the *pulsus myurus*, in which a full and forcible pulse-wave is followed by a series of several beats gradually decreasing in volume, this succession of changes being maintained with a certain degree of regularity.

The rhythm of the pulse may further be disturbed in such a way that the blood waves do not arrive at the two wrists at precisely the same moment. This inequality is met with when the aorta is the seat of aneurismal swelling, circulation being delayed in the arteries of the side towards which the aneurism lies; it is most

evident when the tumour is situated on the arch of the aorta, between the vessels which spring from it,—the innominate artery (or right subclavian) and left subclavian.

In other cases of aneurism, especially of the ascending aorta, the pulse in the radial arteries is not indeed unequal, but is considerably postponed; instead of occurring directly after the cardiac systole, it does not appear till a distinctly appreciable interval has elapsed. This is also sometimes caused by stenosis of the aortic orifice, from the longer duration of the systole in that affection. And in the severer forms of aortic insufficiency the pulse, more particularly that of the carotids, is not synchronous with the heart's impulse, but is felt an instant later, a circumstance which has been explained by the supposition that the blood projected into the aorta at the beginning of the systole encounters the regurgitating blood-stream, and is therefore later in reaching the arteries of the neck (Tripier).—Finally, large aneurisms of the descending aorta tend to retard the pulse-wave, so that it is not perceptible in the femoral arteries so soon as in the radials.

3. Intermission of the Pulse.

In observing the pulse it is often noted that after several regular strokes one or sometimes two are omitted. This depends on one of two conditions: either the heart's action is periodically interrupted (*pulsus deficiens*), which is most commonly the case, or more rarely certain of its contractions, though regular enough, are not sufficiently energetic to give rise to a corresponding throb of the radial arteries. Such an intermittent pulse is sometimes seen to be compatible with the enjoyment of perfect health in other respects; it presents itself also in very diverse affections, independently of any disease of the heart, though in a large number of cases it is associated with positive cardiac disorder. It is often connected with a partially-filled or shrunken state of the left ventricle (from mitral stenosis or mitral incompetency), when an abnormally small quantity of blood is thrown into the aortic arterial system on each contraction of the heart; it is most frequently due, however, to that diminution of the heart's contractile power which takes place in the later stages of every cardiac disease.

4. Volume of the Pulse.

The largeness or smallness of the pulse depends on that of the blood-wave which passes through the radial artery, and this again depends, *cæteris paribus*, on the capacity of the artery at the wrist. Even in health the circumference of these vessels is very different in different persons, some having wide arteries and a full pulse, others slender arteries and a small pulse; between those extremes numerous gradations are observed. The volume of the pulse in health and disease also varies with the energy of the heart's action, though even in the absence of any undue excitement of the organs of circulation many individuals present a pulse the strokes of which are very unequal. When the radial artery is permanently distended, as in insufficiency of the aortic valves, it becomes the seat of persistent pathological *dilatation*, and the pulse is in consequence *increased in volume*. On the other hand, diminution of the calibre of the artery and of the volume of the pulse takes place when the quantity of blood circulating in the systemic arteries is abnormally small, a condition which is realised in the following circumstances: in stenosis of the aortic orifice; in cases in which the descending aorta or the aortic arch is compressed by morbid growths, such as mediastinal tumours; when the arteries of the body generally are unduly contracted; in all diseases of the heart in which the systemic arteries are deprived of their proper share of the blood in circulation, from congestion of the pulmonary vessels and of the whole venous system—in mitral stenosis, mitral insufficiency, &c. The pulse always becomes smaller as the heart's action begins to fail: if the heart be very seriously enfeebled, as it is in the last stages of those affections which terminate fatally, and temporarily in ordinary cases of fainting, pulsation is so slight as to cause scarcely any appreciable elevation of the artery (*threaddy pulse*) or merely a slight quivering movement is communicated to the arterial wall (*tremulous pulse*). In the asphyxial stage of cholera the radial pulse disappears altogether.

Rhythmical variations are sometimes observed in the volume of the pulse, dependent on the influence of the respiratory movements; the characteristic features of this sign are that *simultaneously with each inspiration* the pulse-wave in all the arteries is *reduced* in magnitude, or is absolutely *suppressed* on making a full and deep inspiration, but returns to its normal