PERCUSSION OF THE HEART.

Percussion of the heart is practised with one of two objects in view,—either the delimitation of those parts of the anterior surface of the heart which, not being covered by lung, are in immediate contact with the chest-wall, or the definition also of those which are situated more deeply, behind portions of the pulmonary tissue. The superficial cardiac dulness may usually be mapped out with a considerable degree of precision; the percussion of the deeper parts, on the other hand, is attended by more difficulty and uncertainty.—It will contribute materially to a clear understanding of the subject if the discussion of details be prefaced by a short description of the position of the heart in relation to the thoracic parietes and the anterior margins of the lungs. The axis of the heart is directed from above downwards, forwards, and to the left, the organ being so placed behind the anterior wall of the chest that two-thirds of its bulk fall to the left of the median line of the sternum and one-third to the right. The highest point of the heart, the uppermost part of the left auricle, is found at the level of a line joining the lower edges of the sternal insertions of the second ribs (right and left); the lowest point of the heart, the apex, lies immediately behind the sixth left costal cartilage, to the inside of the mammillary line. The *left* boundary of the heart, formed by the left border of the organ, corresponds with a line passing from the second left intercostal space downwards to the apex of the heart, describing a curve the convexity of which is turned outwards, and whose greatest distance from the middle line of the sternum amounts to 8—9 ctm. The *right* boundary, which coincides with the right border of the heart, is represented by a line starting from a point in the second right intercostal space close to the sternum, terminating opposite the sternal insertion of the fifth right rib, slightly convex outwardly, and distant 2—3 ctm. from the right edge of the breast-bone. If from the lower end of the last-mentioned line to the apex of the heart another line be drawn, the latter will mark the *lower* boundary of the heart, formed by the wall of the right ventricle.

In the space enclosed within these limits lies the heart, for the most part covered by lung. A certain portion of its surface, however, defined by the anterior margins of the lungs, is not so covered in. As already stated (see p. 108) the lungs are in close apposition anteriorly from the second to the level of the fourth rib, being separated only by the anterior mediastinal fold of the pleuræ. From this point upwards, therefore, the superior segment of the heart,—both auricles and a part of the ventricles,—is completely hidden by pulmonary tissue.

At the level of the fourth rib the lungs diverge, the anterior margin of the left passing outwards through the fourth left intercostal space, turning downwards and a little inwards opposite the fifth costal cartilage, and ending in the lower border behind the cartilage of the sixth rib. The greater part of the right ventricle, and the apex of the left, are thus exposed; the rest of the left ventricle, very little of which indeed appears on the front of the heart, remains concealed.—The anterior border of the right lung turns outwards at a lower point than the left, opposite the sternal insertion of the fifth right costal cartilage; it merges immediately, at the level of the sternal end of the sixth rib, in the lower border of the lung. In following this course it overlaps to a slight extent that part of the right ventricle which lies farthest to the right.

It is thus seen that the segment of the heart between which and the chest-wall no lung-tissue is interposed belongs, with the exception of the apex, exclusively to the right ventricle, and includes little more than the half of that part of the organ. Its extent, also, is not constant; it varies somewhat with the differences frequently observed in the configuration of the lungs. Even in the same individual the movements of respiration are found to affect very considerably the anatomical relations of the heart: during inspiration the edges of the lungs converge and encroach still further on the anterior surface of the right ventricle, and if the inspiration be deep and energetic the entire heart may be so closed in; forcible expiration, on the other hand, causes the margins of the lungs to retire, and a larger part of the heart's surface then comes to the front.

Over the whole of the space described as not occupied by lung, except a narrow portion behind and to the right of the sternum, the percussion-sound is dull; this is termed the *absolute*

cardiac dulness, or, as it coincides with the more superficial part of the surface of the heart, the *superficial* dulness. It is to be distinguished from the less markedly dull sound given by the rest of the præcordial region, which is designated the *relative* cardiac dulness.

Before proceeding to the percussion of the heart the situation of the apex-beat should first be ascertained, as this indicates at once the inferior limit of the cardiac dulness and thus facilitates its delimitation; the points are then to be determined at which the clear pulmonary percussion-note passes into the dull sound yielded by the heart. The *upper* limit of the *absolute cardiac dulness* begins usually *at the upper border of the fourth left rib;* the *left* coincides with a slightly curved line passing from the superior border of the fourth rib to the apex of the heart, *inside the mammillary line;* the *right* is marked by the *left edge of the sternum from the fourth to the sixth rib.* The lower boundary, which corresponds with the lower border of the right ventricle, is not definable, as the cardiac sound is here continuous with that of the adjacent left lobe of the liver; it may be represented, however, by a line drawn from the sixth chondro-sternal articulation to the spot at which the apex-beat is felt. This space, the shape of which, when traced with black dermographic crayon, is seen to be that of an irregular four-sided figure, is not accurately commensurate with the superficial portion of the heart, as will be obvious on referring to the description already given of the anatomical relations usually subsisting between the heart and the margins of the lungs; to the right of the left border of the sternum lies a part of the right ventricle not overlapped by pulmonary tissue, yet the percussion-note over it (at the middle of the breast-bone, towards its lower end) is not dull, but of the normal pulmonary quality, clear and of low pitch. The cause of this can only be that the sternum, from the readiness with which it enters into vibration, transmits the force of the percussion-stroke to the adjoining lung, so that the slight dulness which the right ventricle really gives is overborne by the clearness of the pulmonary note. This explanation is supported by the observation that on placing the hand on the sternum, and in that way diminishing its power to vibrate, the previously clear sound becomes somewhat muffled.

The extent of the heart's surface not covered-in by lung being,

as already noticed, subject to constant variation during the movements of inspiration and expiration, the dimensions of the region of absolute cardiac dulness show similar changes; the limits above set down, therefore, are applicable only to conditions in which the respiration is perfectly superficial, when the differences referred to are so trifling as scarcely to vitiate the results obtained by percussion. It is always necessary, however, to direct the patient to cease breathing when absolute precision in the delimitation of the heart is required, particularly in determining its boundaries superiorly and to the left. Deep inspiration reduces the area of cardiac dulness both in height, as the upper limit sinks downwards, and in breadth, as the left boundary-line moves inwards; only the right border of the region in question remains unchanged.—Whether the patient lies on his back, sits, or stands, is immaterial so far as the accuracy of the results is concerned; but on turning to one or other side the position of the apex-beat is altered and that of the cardiac dulness with it, the latter being diminished to the left and superiorly if the patient be on his right side and enlarged in the same directions if he be on his left. The boundaries of the heart to the right are as little influenced by attitude as by the movements of respiration.

The *intensity of the absolute cardiac dulness* is very inconsiderable, the organ percussed being but small; the stroke must therefore be light, in order to avoid awakening simultaneous vibration in the contiguous portions of the lungs, otherwise the true heart-sound will be lost in the clear pulmonary note. It is necessary to proceed with similar caution in examining the lower part of the præcordial region, particularly in children, as the tympanitic tone derived from the stomach may mask the dull sound belonging to the heart. Simple finger-percussion will be found the method best adapted to the determination of the absolute cardiac dulness.

Those portions of the heart which are overlapped by lung are inaccessible to percussion by the ordinary gentle stroke employed in the manner just described, the sound so elicited being loud and clear; a firm stroke, on the other hand, often demonstrates a decided decrease in the loudness of the note as high as the third rib, indicating that here a thinner layer of lung has been caused to vibrate. Such a sound, therefore, though intrinsically clear in quality, is somewhat muffled, that is, *relatively* dull, as compared

with that obtained at other points, behind which only lung is situated. It is chiefly superiorly, towards the upper limit of the præcordial region, that relative dulness is observed on forcible percussion; those other parts of the heart lying behind and to the right of the sternum give no muffling of the sound even in answer to a heavy stroke, and it is only by availing oneself of the sense of resistance communicated to the finger, and at the same time as far as possible eliminating the vibrations of the sternum by pressing on it and in its immediate neighbourhood, that they can be recognised by means of percussion. But even this method fails to demonstrate clearly that portion of the right ventricle which is beyond the right edge of the sternum. To define precisely the *whole* of the anterior surface of the heart is thus impossible; most commonly, therefore, nothing more is attempted than the delimitation of the area which is not sheltered behind pulmonary tissue.—It is obvious that the extent of this superficial cardiac dulness is no absolute guide to the real size of the organ within, as there is no constant relation between the covered and the non-covered parts of the heart, on account of the irregularities so often displayed in the contour of the lungs anteriorly. Nevertheless the dimensions of the region in question usually warrant a general inference as to the presence or absence of enlargement of the heart, as such enlargement is always associated with increase of the area absolutely dull.

In certain circumstances the absolute cardiac dulness may extend beyond the limits above stated, even while the heart remains normal in point of size, as, for example, when the processes of lung which as a rule are found in front of the base of the heart, are atrophied and retracted, permitting the whole of the anterior surface of the heart to come into contact with the chest-wall.

The area of cardiac dulness is, on the contrary, lessened, when the heart, though still of normal size, is shut in to an unusual extent by the lungs. The lungs encroach thus on the heart when their anterior margins are less divergent than is generally the case, or when they are unduly inflated, as in emphysema. The heart may also be pushed backwards and separated from the chest-wall by the accumulation of gas in the pericardium,—a very rare event, when the whole præcordial region renders a clear tympanitic note instead of the normal dull sound; or there may

be air in the pleural sac, when the percussion-sound over the heart becomes tympanitic or metallic in quality; or there may be fluid in the pleura, when the cardiac dulness is indistinguishable from that of the left side generally,—provided the heart be not displaced.

The *cardiac dulness is increased* in extent and intensity *in hypertrophy and dilatation of the heart*, this augmentation being most manifest in its *length* in enlargement of the *left* ventricle, and in its *breadth* in enlargement of the *right* ventricle; the dull area further takes a somewhat *conical* form when the *pericardium is filled with fluid*.

In hypertrophy and dilatation of the left ventricle the point at which the cardiac impulse is felt, below and to the outside of its normal situation, offers a ready means of determining approximately the extension of the area of dulness in an outward direction. In such cases also the fixing of the upper limit of the cardiac dulness is exceedingly easy, as the lung, provided it have not contracted adhesions, is pushed aside by the enlarged heart, which then comes closer to, or even touches, the thoracic parietes.

Similarly, in cases of marked hypertrophy and dilatation of the right ventricle the undue propagation of the heart's impulse towards the right at once indicates the nature, and roughly the extent, of the physical change, though usually the non-resonance to percussion, even when the dilatation of the right heart is considerable, is not very apparent beyond the midsternal line.

It often happens that those who have not had much experience in the art of percussion do not consider as dull, or as in any way connected with the heart, the somewhat clearer sound obtained over the sternum in examining from left to right; but on comparing it with the normal pulmonary note, or on percussing still further towards the right till the true lung-sound is educed, the area of dulness associated with enlarged heart is soon seen to be larger than at first suspected.

Slight dilatations of the right heart can be made out only by means of the sense of resistance experienced by the finger in percussing. In cases of marked dilatation of the right ventricle not only does the cardiac dulness far overpass its normal boundaries to the right, but it goes also somewhat beyond them to the left, as is shown by the slight outward displacement of the apex-beat. This is due to the more *horizontal* position which the heart assumes in such circumstances, the necessary result of which is that the apex of the heart is carried further to the left.

Hypertrophy and dilatation of the heart, however, are not in every instance characterised by extension of the præcordial dulness; this sign is absolutely wanting when the overlapping processes of lung are of unusual depth or cover over a larger portion of the surface of the heart. Thus, in vesicular emphysema of the lungs the attendant enlargement of the right heart is frequently unrecognisable by objective examination.

Even with a heart perfectly normal in size, an apparent increase of the area it renders dull to percussion is apt to be produced by various diseases of the adjacent pulmonary texture, such as consolidation (from infiltration, compression, &c.)

It is sufficient merely to mention cases of this kind; to enumerate the signs by which they may be differentiated (certain alterations in the outline of the region of percussion-dulness, &c.,) is perfectly unnecessary, in view of the impossibility of falling into error in the diagnosis. Simple inspection of the præcordial region frequently suffices, as already pointed out, for the positive recognition of hypertrophy of the heart, and the absence of the phenomena formerly described (p. 212 *et seq.*) shows unmistakeably that the increase of the dull area must be due to some other cause.

The area of cardiac dulness is observed to take a peculiar form in cases of pericardial exudation and transudation. If the quantity of fluid be very large, the pericardial sac is fully distended; it is enlarged chiefly in its lower part, while superiorly it gradually diminishes in breadth. The space thus rendered dull is irregularly *triangular* in shape, the *base* of the figure being *downwards*, the *apex* pointing *upwards*. Its size depends on the amount of the exudation; if the effusion be very abundant the base of the triangle may extend from the right parasternal line almost to the left axillary line, while the two remaining sides may be represented by converging lines drawn from the two extremities of the base, meeting in the second intercostal space, and forming there a somewhat obtuse angle. A less considerable amount of exudation is characterised by a proportionately smaller triangle of dulness; in the earlier stages of the affection, also, the non-resonant region has no distinctive outline, dulness being detected both at the base of the heart, where the exudation usually first appears, and in the lower part of the pericardium. The distension of the lower portion of the pericardial sac is recognised by the fact that the dulness extends further to the left than the apex-beat of the heart, a sign which is always a

conclusive indication of the existence of pericardial exudation. A very copious effusion completely suppresses the apex-beat; disappearance of the latter, therefore, and a præcordial dulness of the characteristic triangular form, may be accepted as positive proof of the presence of a large pericardial exudation.—And further, as the layer of fluid is so much deeper below (next the diaphragm) than above (towards the roots of the great vessels) the non-resonance is more marked at the lower than in the upper part of the præcordial region; the sound indeed is rendered absolutely dull inferiorly. On causing the patient to lie on his back the fluid at once subsides to the hinder part of the pericardium, diffusing itself equally over its posterior surface, the apex-beat again becomes appreciable, and the percussion-sound somewhat clearer in front, the edges of the lungs being now allowed to expand freely and to fill up the space left vacant by the shifting of the effusion. A similar change in the quality of the sound is noticed on turning to the right or left side: in the former case the sound clears to the left, in the latter it clears to the right.—These statements regarding pericardial exudation apply with still greater force to the more mobile fluid poured out in cases of pericardial *transudation* (hydropericardium).

This variation of the sounds on changing the position of the patient is wanting only when the two opposed surfaces of the pericardium are glued together at several points by inflammatory products, or when the sac is so fully distended that movement of its contents becomes impossible. Such cases, however,—in which the pericardium is rendered so tense by the quantity of fluid it contains as to be incapable of further expansion,—do not seem ever to occur in practice; in one example of enormous hydropericardium which I saw (in which the dulness reached from the left axillary line almost to the right mammillary line, and upwards as far as the third rib) the percussion-sound was found to vary as usual with the position of the patient.