

getting the patient to walk briskly up and down the room a few times. Such lesions are usually comparatively slight.¹ On the other hand, murmurs which become more marked as a result of rest are generally of the severest type (see above, p. 190).

Organic murmurs are usually better heard at the end of expiration and become fainter during inspiration as the expanding lung covers the heart. This is especially true of those produced at the mitral valve, and is in marked contrast with the variations of functional murmurs which are heard chiefly or exclusively at the end of inspiration.

(9) *Sudden Metamorphosis of Murmurs.*—In acute endocarditis, when vegetations are rapidly forming and changing their shape upon the valves, murmurs may appear and disappear very suddenly. This metamorphosing character of cardiac murmurs, when taken in connection with other physical signs, may be a very important factor in the diagnosis of acute endocarditis. In a similar way relaxation or rupture of one of the tendinous cords, occurring in the course of acute endocarditis, may effect a very sudden change in the auscultatory phenomena.

“*Functional Murmurs.*”

Not every murmur which is to be heard over the heart points to disease either in the valves or in the orifices of the heart. Perhaps the majority of all murmurs are thus unassociated with valvular disease, and to such the name of “accidental,” “functional,” or “hæmic” murmurs has been given. The origin of these “functional” murmurs has given rise to an immense amount of controversy, and it cannot be said that any one explanation is now generally agreed upon. To me the most plausible view is that which regards most of them as due either to a temporary or permanent dilatation of the conus arteriosus, or to pressure or suction exerted upon the overlapping lung margins by the cardiac contractions. This explains only the systolic functional murmurs, which make up ninety-nine per cent. of all functional murmurs. The diastolic functional murmurs, which undoubtedly occur, although with exceeding rarity,

¹ For exception to this see below, page 215.

are probably due in most cases to sounds produced in the veins of the neck and transmitted to the innominate or vena cava.

Characteristics of Functional Murmurs.—(1) Almost all functional murmurs are systolic, as has before been mentioned.

(2) The vast majority of them are heard best over the pulmonic valve in the second left intercostal space. From this point they are transmitted in all directions, and are frequently to be heard, although with less intensity, in the aortic and mitral areas. Occasionally they may have their maximum intensity in one of the latter positions.

(3) As a rule, they are very soft and blowing in quality, though exceptionally they may be loud and rough.

(4) They are not associated with any evidence of enlargement of the heart nor with accentuation of the pulmonic second sound.¹

(5) They are usually louder at the end of inspiration.

(6) They are usually heard over a very limited area and not transmitted to the left axilla or to the back.

(7) They are especially evanescent in character; for example, they may appear at the end of a hard run or boat race or during an attack of fever, and disappear within a few days or hours. Respiration, position, and exercise produce greater variations in them than in “organic” murmurs.

(8) They are especially apt to be associated with *anæmia*, although the connection between anæmia and functional heart murmurs is by no means as close as has often been supposed. The severest types of anæmia, for example pernicious anæmia, may not be accompanied by any murmur, while, on the other hand, typical functional murmurs are often heard in patients whose blood is normal, and even in full health. Yet in three cases of intense anæmia I have heard *diastolic* murmurs loudest at the fourth left costal cartilage and leading to a diagnosis of aortic regurgitation. At autopsy the aortic valves were in each case sound, and I am at a loss

¹ In chlorosis the second pulmonic sound is often very loud (owing to the retraction of the lungs and uncovering of the conus arteriosus) and associated with a systolic murmur.

to account for the murmurs.¹ It should not be forgotten that a real, though temporary, leakage through the mitral or tricuspid valve may be associated with anæmia or debilitated conditions owing to weakening of the papillary muscles or of the mitral sphincter. In such cases we find *not* the signs of a functional murmur, as above described, but the evidence of an organic valve lesion hereafter to be described.

The distinctions between organic and functional heart murmurs may be summed up as follows:

Organic murmurs may occupy any part of the cardiac cycle; if systolic, they are usually transmitted either into the axilla and back or into the great vessels of the neck; they are usually associated with evidences of cardiac enlargement and changes in the second sounds at the base of the heart, as well as with signs and symptoms of stasis in other organs. Organic murmurs not infrequently have a musical or rasping quality, although this is by no means always the case. They are rarely loudest in the pulmonic area and are relatively uninfluenced by respiration, position, or exercise.

Functional murmurs are almost always systolic in time and usually heard with maximum intensity in the pulmonic area. They are rarely transmitted beyond the precordial region and are usually loudest at the end of inspiration. They are not accompanied by evidences of cardiac enlargement or pathological accentuation of the second sounds at the base of the heart, nor by signs of venous stasis or dropsy. They are very apt to be associated with anæmia or with some special attack upon the resources of the body (*e.g.*, physical overstrain or fever), and to disappear when such forces are removed. They are usually soft in quality; never musical. The very rare diastolic functional murmur occurs exclusively, so far as I am aware, in conditions of profound anæmia; *i.e.*, when the hæmoglobin is twenty-five per cent or less. It can be abolished by pressure upon the bulbus jugularis, and can be observed, if followed up into the neck, to pass over gradually into a continuous venous hum with a diastolic accent.

¹ Cabot and Locke, Johns Hopkins Bulletin, May, 1903.

Cardio-Respiratory Murmurs.

When a portion of the free margin of the lung is fixed by adhesions in a position overlapping the heart, the cardiac movements may rhythmically displace the air in such piece of lung so as to give rise to sounds which at times closely simulate cardiac murmurs. These conditions are most often to be found in the tongue-like projection of the left lung, which normally overlaps the heart, but it is probably the case that cardio-respiratory murmurs may be produced without any adhesion of the lung to the pericardium under conditions not at present understood. Such murmurs may be heard under the left clavicle or below the angle of the left scapula, as well as near the apex of the heart,—less often in other parts of the chest.

Cardio-respiratory murmurs may be either systolic or diastolic, but the vast majority of cases are systolic. The area over which they are audible is usually a very limited one. They are greatly affected by position and by respiration, and are heard most distinctly if not exclusively during inspiration, especially at the end of that act. (This fact is an important aid in distinguishing them from true cardiac murmurs, which are almost always fainter at the end of inspiration.) They are also greatly affected by cough or forced respiration or by holding the breath, whereas cardiac murmurs are relatively little changed thereby. Pressure on the outside of the thorax and in their vicinity may greatly modify their intensity or quality, while organic cardiac murmurs are but little influenced by pressure. As a rule, they have the quality of normal respiratory murmur, and sound like an inspiration interrupted by each diastole of the heart.

In case the effect of the cardiac movements is exerted upon a piece of lung in which a catarrhal process is going on, we may have systolic or diastolic explosions of râles, or any type of respiratory murmur except the bronchial type, since this is produced in solid lung which could not be emptied or filled under the influence of the cardiac movements. Cardio-respiratory murmurs have no special diagnostic significance, and are mentioned here only on account of the im-

portance of not confusing them with true cardiac murmurs. They were formerly thought to indicate phthisis, but such is not the case.

Murmurs of Venous Origin.

I have already mentioned that the venous hum so often heard in the neck in cases of anæmia may be transmitted to the region of the base of the heart and heard there as a diastolic murmur owing to the acceleration of the venous current by the aspiration of the right ventricle during diastole. Such murmurs are very rare and may usually be obliterated by pressure upon the *bulbus jugularis*, or even by the compression brought to bear upon the veins of the neck when the head is sharply turned to one side. They are heard better in the upright position and during inspiration.

Arterial Murmurs.

(1) Roughening of the arch of the aorta, due to chronic endocarditis, is a frequent cause in elderly men of a systolic murmur, heard best at the base of the heart and transmitted into the vessels of the neck. Such a murmur is sometimes accompanied by a palpable thrill. From cardiac murmurs it is distinguished by the lack of any other evidence of cardiac disease and the presence of marked arterio-sclerosis in the peripheral vessels (see further discussion under Aortic Stenosis, p. 239, and under Aneurism, p. 282).

(2) A narrowing of the lumen of the subclavian artery, due to some abnormality in its course, may give rise to a systolic murmur heard close below the clavicle at its outer end. The murmur is greatly influenced by movements of the arm and especially by respiratory movements. During inspiration it is much louder, and at the end of a forced expiration it may disappear altogether. Occasionally such murmurs are transmitted through the clavicle so as to be audible above it.

(3) Pressure exerted upon any of the superficial arteries (carotid, femoral, etc.) produces a systolic murmur (see below, p. 237). Diastolic arterial murmurs are peculiar to aortic regurgitation.

(4) Over the anterior fontanelle in infants and over the gravid uterus systolic murmurs are to be heard which are probably arterial in origin.

CHAPTER X.

DISEASES OF THE HEART.

VALVULAR LESIONS.

CLINICALLY it is convenient to divide the ills which befall the heart into three classes:

- (1) Those which deform the cardiac valves (valvular lesions).
- (2) Those which weaken the heart wall (parietal disease).
- (3) Congenital malformations.

Lesions which affect the cardiac valves without deforming them are not often recognizable during life. The vegetations of acute endocarditis¹ do not usually produce any peculiar physical signs until they have so far deformed or obstructed the valves as to prevent their opening or closing properly.

The murmurs which are often heard over the heart in cases of acute articular rheumatism cannot be considered as evidence of vegetative endocarditis unless valvular deformities, and their results in valvular obstruction or incompetency, ensue. The chordæ tendineæ may be ruptured or shortened, thickened, and welded together into shapeless masses, but if these deformities do not affect the action of the valves we have no means of recognizing them during life. Congenital malformations are practically unrecognizable as such. If they do not affect the valves, we cannot with any certainty make out what is wrong.

For physical diagnosis, then, heart disease means either de-

¹ See Appendix.