

blood ceases to be expelled through the orifice. Showing that it is during the contraction of the ventricle, that the parietes of the aorta assume a firm and tense condition and exert a rapid reaction on their contents. And if we carefully observe these movements whilst our fingers are gently placed against the sides of the ventricle and aorta, we perceive that this firm and tense condition of the aorta terminates as the contraction of the ventricle terminates and in unison with it. That the instant the dilatation of the ventricle commences or its walls relax the parietes of the aorta assume the same relaxed condition, becoming soft and compressible, which condition extends from the ventricle to the aorta. Hence during the dilatation of the ventricle, the blood in the aorta could not fall back against the semilunar valves with a force sufficient to produce the second sound of the heart.

Carpenter says, "The first sound is evidently synchronous with the impulse of the heart against the parietes of the chest, and also with the pulse as felt near the heart." And Dr. Wood\* states, "The first sound is heard during the contraction or systole of the ventricle, and is synchronous with the beating of the ventricle, and with the pulsation in the large arteries near the centre of circulation, but anticipates by a very minute, but still appreciable interval, the pulse at the wrist." Muller† also observes, "The pulse being dependent on the contraction of the ventricle, is in general synchronous with it." And Dr. Hope‡ states precisely the same fact, when he says, "Synchronous with the ventricular systole, are, the first sound of the heart, the impulse of the apex against the ribs, and in vessels near the heart, the pulse." For, if these be simultaneous, it is very evident, that the first sound is synchronous with the ventricular systole, the impulse of the apex against the ribs, and the pulse in arteries near the heart. And we have seen in our experiments, that when the ventricle contracts, and propels the blood into the aorta, it distends its walls and a pulsation is produced which terminates the first sound of the heart, synchronous with which the blood recoils against the semilunar valves as it is transmitted forwards with increased velocity.

In experiments on the aorta, it has been ascertained by Drs. Hope and Williams, and by the Dublin committee and others, that a sound is produced as the blood recoils against the semilunar valves; and that the sound disappeared or was converted into a hissing when one of the laminae of the valves was injured or hooked back. But this recoil of the blood against the semilunar valves

must have been produced by the systole of the aorta as the parietes reacted with force on their contents; and that was synchronous with the contraction of the ventricle, and the termination of the first sound. For physiologists are agreed that the first sound is synchronous with the contraction of the ventricle, and also with the systole of the arteries near the heart. And if the second sound of the heart be produced by the falling back of the blood in the aorta against the semilunar valves, during the dilatation of the ventricle, then, according to that view, the blood must fall back twice in succession or recoil against the semilunar valves and produce a sound, during what these physiologists consider one beat of the heart: first, during the systole; and, second, during the dilatation of the ventricle; for, according to Dr. Hope, the first part of the dilatation of the ventricle succeeds the ventricular systole, and the latter part precedes the next systole.

The whole question resolves itself into this, if the systole of the aorta and the arteries near the heart be synchronous with the contraction of the ventricle, then, the blood must recoil against the semilunar valves during the first sound of the heart, and constitute the termination of that sound; and if the second sound depends on the blood in the aorta falling back against the semilunar valves, during the dilatation of the ventricle, the blood must recoil twice against these valves in immediate succession, during every beat of the heart, and on each occasion produce a sound. But in the course of our experiments we have seen, that when the ventricle commences to dilate, its parietes become soft and relaxed, and this condition extends to the aorta, so that the blood could not then fall back with force, and produce the second sound of the heart.

When the ventricle contracts and propels the blood into the aorta, the aorta synchronously pulsates; and this pulsation is the distended parietes reacting on their contents, by which the blood recoils against the semilunar valves as it is transmitted onwards. Withdraw the cause of the distension of the aorta, by the ventricle relaxing and beginning to dilate, and the cause of the rapid reaction of the aorta on its contents ceases, "the parietes then straighten themselves and recover their former situation."—Muller, p. 199. Hence the blood cannot fall back with force against the semilunar valves, during the dilatation of the ventricle, so as to produce the second sound of the heart.

With regard to the time at which the auricles contract, it is generally believed that they contract immediately before the contraction of the ventricle, and not immediately after the termination of the preceding contraction. Harvey, Lancisi, Senac

\* Wood's Medicine, Philadelphia.

† Muller's Physiology.

‡ Hope on the Heart, p. 22.