

and Haller considered that the contraction of the auricles immediately precedes that of the ventricles, and that the one movement passes rapidly into the other. Dr. Hope also maintained this doctrine, as the result of his experiments, and Professor Turner, arguing on this data, shewed that the second sound could not be produced by contraction of the auricles, as, according to these views, it ought immediately to precede and not to succeed the first sound of the heart. Now it is a fact, that when the action of the heart is slow, as in the frog, when it pulsates at the rate of 20 times a minute, the ventricle immediately dilates after its contraction, and blood passes into it from the distended auricles, filling it to a certain extent, and then the auricles contract and produce contraction in the ventricles, the one movement immediately preceding the other. The same thing occurs in warm-blooded animals, after the thorax has been opened, when the action of the heart becomes slow and irregular, or its movements are interfered with, as by preventing the action of any of its valves. In these cases we have observed, that after contraction, the ventricle immediately dilates to a certain extent, and blood passes into it from the distended auricles, and then the auricles contract and produce contraction of the ventricle. But we are by no means from this data to conclude, that this is the manner in which the action of the heart is maintained when it is quick and vigorous, beating, as in warm-blooded animals, at the rate of 70, 80 and 90 pulsations per minute. We have shewn in a previous paper,\* that as the action of the heart increases, the auricles contract sooner in point of time and of rhythm, till their contraction becomes synchronous with the diastole of the ventricle, so that they commence to contract immediately after the termination of the ventricular contraction. And let a physiologist examine the action of the heart when it has been quickly denuded in a warm-blooded animal, and he will see that the auricles contract immediately after the preceding contraction of the ventricles is finished—and that the action is maintained with surprising power, the one movement following the other in quick and regular succession.

In all these experiments on the turtle, the cycle of movements or beat of the heart commenced with the auricles contracting synchronously with the diastole of the ventricle; which being completed excited the ventricular systole that terminated the cycle; another beat commenced and ended in the same manner. But so rapidly did the contraction of the auricles succeed the termination of the preceding ventricular systole, that a movement could

often be observed in the auricles beginning to contract, and the contraction of the ventricle scarcely finished, so that only an appreciable interval occurred between the two movements or beats; the contraction of the auricles constituting the first part of the beat, and the contraction of the ventricle the second part or its termination, and then the auricles contracting as the preceding systole terminated. But, on listening to the sounds through the medium of the stethoscope, the order of the movements seemed to be reversed. The dull prolonged sound synchronous with the contraction of the ventricle appeared to be the first sound of the heart, and the short acute sound synchronous with the contraction of the auricle, appeared the second sound, and immediately to succeed the (first) sound only an appreciable interval intervening between the two sounds, which interval occurs between one beat of the heart and the commencement of another, and between the termination of the contraction of the ventricle and the commencement of the contraction of the auricles, that is, according to received phraseology, between the first and the second sounds of the heart, but in reality between the termination of the greater or second sound, and the commencement of the first or shorter sound. It is this interval that constitutes what is termed the first pause or period of silence between what is termed the first and second sounds of the heart. It depends on the auricles commencing immediately to contract after the contraction of the ventricle is finished, and when the action of the heart is vigorous that interval can scarcely be appreciated.

The short, sharp sound termed the second sound of the heart, but in reality the first, is synchronous with the contraction of the auricle and dilatation of the ventricle, and the moment of silence occurs as the ventricle attains the point of distension and commences to contract.

It is generally believed that no sound is produced by the vigorous contraction of the auricles. But Dr. Williams,\* "in some recent experiments with Mr. Clendinning, found the auricles of an ass produce a very distinct sound when they contracted vigorously, and independently of the ventricles. This was afterwards heard by all who were present. The same phenomenon has been also observed in some experiments recently performed in America." † Drs. Pinnock and Moore heard a sound produced by contraction of the auricles, and we have had ample evidence of this fact, in the course of our experiments this summer, on the action of the heart in the American turtle.

With regard to the aortic regurgitant murmur in

\* British Medical Journal, February, 1868.

\* Williams on the Chest.

† Wood's Medicine, Philadelphia