

**Hooping-cough, and what it teaches us of the sounds of the heart / by Andrew Buchanan.**

**Contributors**

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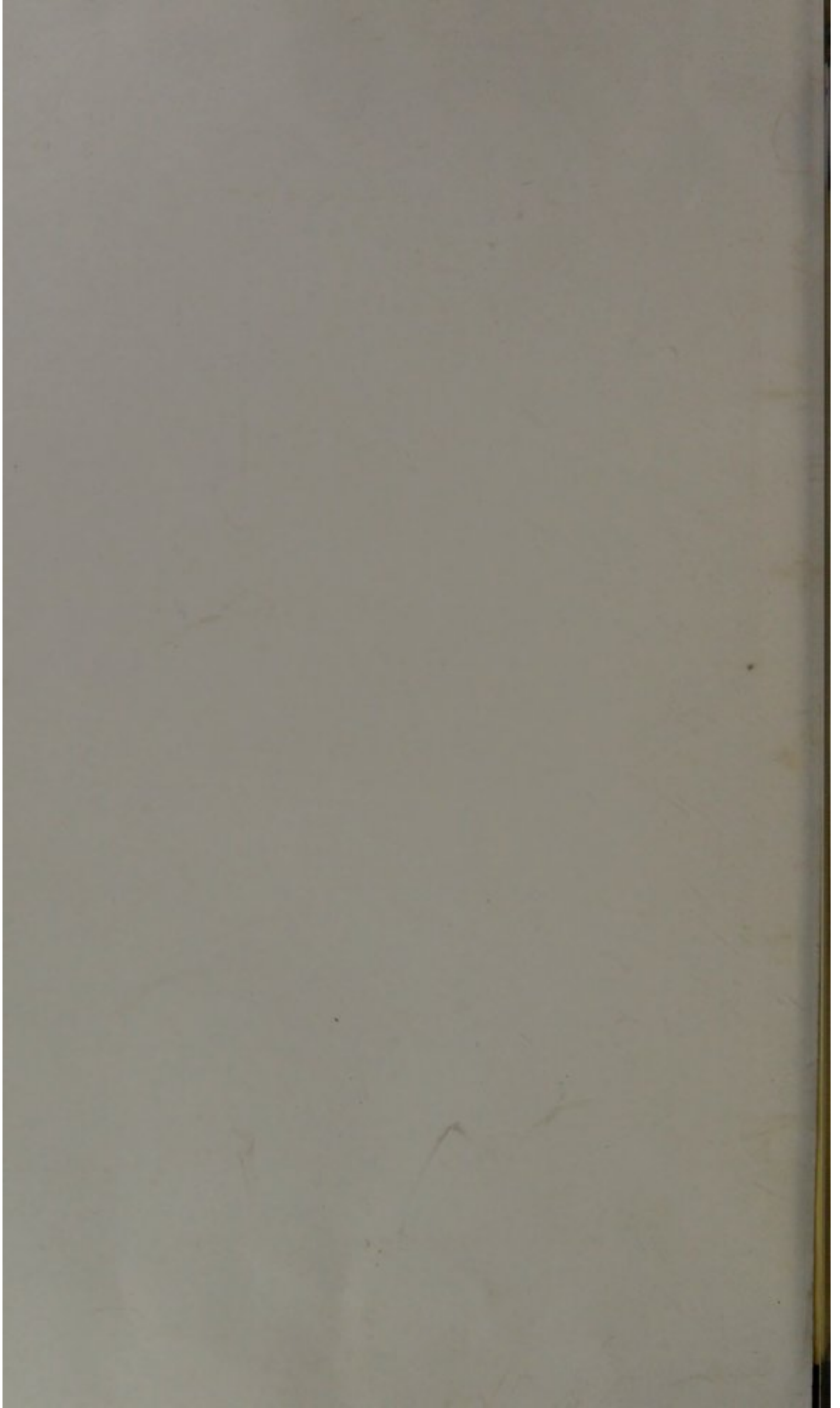
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183 Euston Road  
London NW1 2BE UK  
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E [library@wellcomecollection.org](mailto:library@wellcomecollection.org)  
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## HOOPING-COUGH, AND WHAT IT TEACHES US OF THE SOUNDS OF THE HEART.

By ANDREW BUCHANAN, M.D.,

President of the Faculty of Physicians and Surgeons of Glasgow.

### I. HOOPING-COUGH CONSIDERED PRACTICALLY.

THE returns made to the Registrar-General for the month of January sufficiently show to what a vast extent hooping-cough is now prevailing throughout Scotland, and more especially in the city of Glasgow, 135 deaths being recorded, of which 88, or more than one-half, occurred in Glasgow, and 84 among infants and children under five years of age. There are no statistical data, so far as I know, to determine the average mortality of this disease; but an approximate estimate can be readily formed by any medical man of sufficient experience, if he recall the deaths which have occurred in his own practice—and these are too noteworthy to be easily forgotten—and compare the amount with the estimated number of his patients. Proceeding in this way my estimate is, that the death-rate in hooping-cough is not more than one in forty, or 2.5 per cent. This proportion gives for last month 5,400 as the number of cases throughout Scotland, 3,500 for Glasgow, and 3,360 among infants and children under five years of age.

It is not, then, to be wondered at that so many remedies have been tried for a disease that is not now, for the first time, widely prevalent in this country; nor will it surprise those who have made a study of such remedies how very few of them have stood the test of experience. Is this, then, a sufficient reason for declaring, as so many writers have done, that hooping-cough is an opprobrium to the medical art? I



am so far from being of that opinion, that I have no hesitation in saying that I know no disease in which an intelligent physician, while admitting frankly that he can neither arrest the disease nor even shorten it by a single day, is yet able, by carefully studying the cases committed to his care, to do more good, both in preserving human life and mitigating human suffering; and that not by any panacea or specific remedy, which he prescribes in all cases indiscriminately, but by the judicious use of a very few well known remedies, and by carefully watching over the hygienical condition of his patients.

Of those two methods the latter only is required in the great majority of cases of hooping-cough; I should say in at least from 75 to 80 per cent. These in mild, good weather need never be confined to the house, and require little more attention from the physician than a person in good health, ignorant of medicine. It is quite otherwise in cold, wet weather, when incautious exposure may at once aggravate a mild disease into one of the most serious character; and the physician is required to exert both judgment and authority in imposing restrictions, and seeing that they are obeyed.

Thus it happens that not more than a fourth part of all the cases that occur require medical treatment. But these are so different in form, and in the course which they run, and are fraught with so much danger to life and future health, as to test fully the skill of the physician, and demand his most anxious care.

Four forms of hooping-cough may be distinguished, characterised by the four different ways in which they terminate fatally.

Persons affected with the disease die, according to what I have myself observed, from four causes. 1st. From violent and protracted spasm of the expiratory muscles, causing immediate asphyxia; 2nd, from violent general fever, without any corresponding local affection; 3rd, by exhaustion of strength from the long continuance of a painful and wearing out disease; and 4th, from disorganisation of tissue in the lungs or brain, occurring as a mechanical effect of the violent cough, and causing either speedy death or long continued bad health.

1st. In the ordinary form of the disease the spasmodic action of the muscles of expiration is so prolonged as to interfere with the succeeding act of inspiration, that is, with the free dilatation of the glottis, and the action of the muscles of inspiration; the consequence is, that very little air enters



the lungs, and, in its passage through the half dilated glottis, it causes the tense vocal cords to vibrate, and give out the stridulous sound characteristic of the disease.

At first there is a rapid succession of such attempts at inspiration in every paroxysm of coughing, the diaphragm alone maintaining the unequal contest; but, as the disease advances, the glottis gapes more widely, and the muscles of the ribs reinforce the diaphragm. The effect is that the whooping sound is louder and deeper, and there are two crowing sounds instead of one; the first proceeding from the action of the diaphragm alone, and the second from the concurrence of the whole muscles of inspiration.

The loud and clear double whoop is always a joyful sound, as promising a favourable termination of the disease; but, alas, there are babies and young children who are never destined to give it out. The power of the diaphragm fails, unable to resist the strong and prolonged expiratory spasm, and so complete asphyxia ensues. The only hope now is from the presence of the physician, or of some properly instructed person. The two thumbs should be immediately thrust into the axillæ of the little patient, while the other fingers grasp the shoulders and elevate them to the uttermost. The shoulders are again depressed, and the arms squeezed firmly against the ribs, and these alternate movements should be repeated exactly as in the treatment of asphyxiated persons.

2nd. The second form of the disease is characterised by high general fever, with the usual symptoms of rapid pulse, hurried respiration, great heat of skin, inappetence, and thirst; but without any local inflammatory affection, to which these symptoms can be referred. The fever may continue two or three days, or longer, and terminate by resolution, leaving the patient very much weakened, and indisposed for long after to leave bed, differing, in that respect, so much from the other little people who are importunate to be up. Sometimes, again, the violent fever continues unabated, and terminates fatally in from three weeks to a month. I had the fullest opportunity of observing this form of the disease in two dear little patients, nieces of my own, over whom I watched anxiously from the beginning to the end of their troubles. They were stout, healthy girls, the one of three, and the other of seven years of age. The symptoms in both were very much the same; the most prominent being a rapid pulse, seldom under 130 in the minute, and not deficient in strength, which continued, along with a dry, burning skin, from the beginning to the end of the disease. The cough had the characteristic sound, but was not



severe; the chest exhibited, on the most careful examination, no sign of local disease; and the brain was unaffected. Everything that I could think of, or my medical friends could suggest, was tried, to no purpose; and the patients died in about three weeks from the commencement of the febrile attack. I have ever since been more afraid of this form of the disease than of any other, believing the art of medicine, as at present known, to be impotent before it.

3rd. Patients may die from the long continuance of a painful and wearing out disease. Wine is, in such cases, an invaluable remedy. But I must guard myself from being misunderstood. No child, or young person, should ever taste wine, or any other alcoholic liquid, unless a sufficient reason can be assigned for it. The reason here is manifest. After the disease has continued from three weeks to a month, the strength is more or less impaired, and the child lies in a state of total prostration at the end of the fits of coughing. As soon as it recovers breath, a teaspoonful of wine should be given, with an equal quantity of water. This, even the most hard hearted teetotaller could scarcely refuse to a poor child in such a position; and nothing more is necessary, so long as the child takes food in sufficiency; but as soon as we observe the appetite failing, and too little food taken, we must increase the wine, no longer now as a mere restorative, but as an invaluable article of nourishment, leaving it to those who delight in logomachies about ill-defined terms, to determine whether the wine acts beneficially as a stimulant, a tonic, or an excitant.

4th. Last of all, the violent succussion of the body from the fits of coughing may rupture blood-vessels, or lacerate more extensively the delicate tissue of the brain or lungs, on which their violence is chiefly expended. This is well illustrated by the swollen face and eyelids, which are so common, and still more by the black eyes, like those of a pugilist, which I have occasionally seen. When such a danger is impending, we must use proper means to soothe irritation, and this is best done by the judicious use of opium: which the great Sydenham, the wisest physician the world has yet seen, declared to be the best gift which Almighty God, in compassion for human suffering, had ever bestowed upon mankind—*humano generi in miseriarum solamen concessisset*. When, therefore, the cough is very severe and threatening, we should never hesitate to give a dose of laudanum, containing one drop of the laudanum for every year of the patient's age. It can generally be given with a teaspoonful of water into the stomach; in other circumstances, it may be injected into the rectum, or used



hypodermically; and it should be repeated or not at such intervals as may be required. It may also be applied by rubbing over the spine and chest, but this is objectionable, from the fatigue and exposure which it occasions. All such embrocations and liniments owe their wide popularity to the officiousness of ignorant women, who wish to claim for themselves the whole merit of curing the disease.

I feel confident that these simple remedies and modes of treatment in whooping-cough often do great good, and that they cannot possibly, if judiciously used, do any harm. I cannot, therefore, but recommend them strongly. As to any specific remedy, to be used in every case of the disease, I do not believe that it exists; and have always entertained grave doubts as to the sense, or the honesty, of those who professed such a belief, or followed such a practice.

5th. Such are the forms of simple whooping-cough, and the simple modes of treatment required for them. It is very different when we have to contend against two diseases instead of one; as, when whooping-cough supervenes upon a disease already existing, or, when such a disease supervenes upon whooping-cough. The most common of all such complications, by far, are inflammatory affections of the lungs, produced by imprudent exposure to cold by those labouring under whooping-cough. Not to mention more serious bad effects, the disease, with its characteristic whoop, may be, in this way, protracted even beyond the term of twelve months.

As to the seat of the disease, it is always situated principally, and often solely, in the mucous membrane and glands of the larynx and pharynx; but it generally extends downwards to the mucous membrane of the lungs and stomach, and upwards to every part of the mucous membrane, wherever situated. The eyes and nose are almost always implicated, and the frequent attacks of earache show the affection of the tympanum of the ear. The sentient nerves of these tissues, the pneumogastric, the glossopharyngeus, and the first two branches of the fifth nerve, together with the whole motory circuit in connection with them, are always implicated; not only as arising from irritated tissues, but, in all probability, also from the direct deleterious influence of the morbid poison upon the nervous substance; so that the disease may be placed, with as much propriety, after old Dr. Cullen, among nervous diseases, as among the inflammations, as has been done by more recent writers.

That the disease is infectious, spreading from one child, who catches it at school, to all the rest in a distant home, no man



of any experience can entertain a doubt, neither can he doubt that it attacks persons of all ages.\* Like all such diseases, it depends upon miasms generated and thrown off by the bodies of the sick. These most commonly act by being inhaled by persons breathing air contaminated with them. It is, however, consonant to reason to believe that all infectious diseases were originally, and, therefore, may still be produced by other causes than infection.

## II. HOOPING-COUGH AS A PHYSIOLOGICAL STUDY.

Every medical man must have observed the irregularity of the pulse which occurs more or less in every case of hooping-cough. My attention was first specially called to it in the case of one of my own children, in which it took place to such a degree as to excite my most serious apprehension; and I have ever since observed it with the utmost care, and am now in a position to declare that it is not only an invariable symptom, but one of the highest importance to be noted by the practical physician. It is the best diagnostic symptom, always occurring before the whoop, and in many cases in which the whoop never occurs. It enables him also, by the degree in which it exists, at once to judge of the severity or mildness of the disease, and to tell, before asking a single question, how much his patient may have suffered from it during the preceding twelve hours.

This irregularity of the pulse has been mentioned by a few medical writers, as by Cullen. It is usually ascribed to sympathy and the well known mutual dependence of the functions of circulation and respiration, which is quite true so far as it goes, but very far from being a complete explanation of the whole phenomena that present themselves. Such an

\* These facts are so thoroughly well known that they needed not to be stated, but for the purpose of counteracting the statements of Dr. Martyn, a clever navy surgeon, who, though he cannot have seen much hooping-cough aboard ship, on coming ashore saw thirty cases of it, and has thereupon published an ingenious monograph of the disease. It contains the five following remarkable propositions, which are stated in a sailor-like fashion, boldly and clearly. 1st. That, as a matter of fact, hooping-cough never attacks adults, and that from the structure of the larynx, it is impossible that it can do so. 2nd. That it is not infectious; but is caused mainly by the east wind. 3rd. That it does not prevail anywhere within the tropics, or on the shores of the Mediterranean. 4th. That it was unknown to the ancients; and 5th. That previous to the appearance of the author's monograph, it was the most imperfectly known of all diseases, no less than thirteen different theories, all of them wrong, having been entertained of it.



explanation, however, now that the mechanism of the circulation has been more fully investigated, we are enabled to undertake with more prospect of success.

There are two great reservoirs from which the supply of blood to the heart is obtained, the one for the right side, and the other for the left. The right side is supplied from the mediastinal reservoir, consisting of the great veins and sinus venosus of the mediastinum; while the left side is supplied from the pulmonary veins; and when the circulation is quite regular, an equal quantity of blood flows from each of these reservoirs into the two sides of the heart, so that a perfect equilibrium is maintained.

It must further be remarked that the mediastinal reservoir is of much less relative capacity than the pulmonary, and that, even if it were completely emptied, a single deep inspiration would at once replenish it by sucking blood into it from the mouths of all the large veins that terminate in the thorax. The pulmonary circuit, again, is vastly more capacious; but, when once depleted, it only recovers its complement very slowly by the supply of a regular quantity in a given time, measured out with the utmost exactness by the right ventricle of the heart. Hence it happens that, whenever the relative fulness of the two reservoirs has been disturbed, a certain interval must elapse before equilibrium can be restored, and the length of that interval must depend altogether on the degree of inequality in the quantities of blood contained in the reservoirs.

Let us now observe what takes place in a paroxysm of hooping-cough. A great many forcible expirations are made in succession without any free inspirations intervening. The consequence is that the mediastinal reservoir is soon exhausted of its blood, and not being again replenished, it can only give a rapidly diminishing quantity of blood to the right ventricle to be transmitted to the lungs. The pulmonary reservoir is now depleted in its turn, and can only give an insufficient supply of blood to the left ventricle. The agony of the paroxysm is now at its height, arising not merely from want of breath, but still more from the failure in the quantity of blood supplied to both sides of the heart. When the paroxysm at length terminates, the mediastinal reservoir is at once replenished with blood, and gives a plentiful supply to the right ventricle; but it is long before that ventricle, labour how it may, can restore the complement of blood in the lungs, and during the whole of that time the left ventricle is only partially filled, and sends out a slender stream of blood incap-



able of distending the arteries and producing the small undulating pulse, with an occasional and imperfect beat, which is so characteristic of this disease. When the paroxysms are of frequent recurrence, a second taking place before the deficiency produced by the first has been made up, it is manifest that the deficiency in the lungs must go on augmenting, and this peculiar form of the circulation becomes a permanent symptom till the disease begins to abate.

I have still to advert to another observation in hooping-cough, not less interesting and remarkable than the irregularity of the pulse, and intimately connected with it. This observation I had full opportunity of making, during the last six weeks, upon my own grandchildren, seven in number; all of whom have been, and still are, labouring under hooping-cough, three of them having had it in a very severe form; but I have reason to be thankful, all of them now getting better.

To ascertain, as accurately as possible, the state of the circulation, it was desirable not only to feel the pulse, but to examine also the state of the heart. But what was my astonishment, on applying the stethoscope to the region of the heart, to find the action of that organ quite natural, the two heart sounds, *lub dup, lub dup*, being heard just as usual, without the least derangement of the cardiac rhythm corresponding to the irregularity of the pulse. This being quite contrary to what takes place in all ordinary cases, in which the irregularity of the pulse is accompanied with a corresponding irregularity of the heart's action, from which it manifestly proceeds, I could not but be very much struck with it, and at no little loss to find any explanation of it. At length, however, my thoughts were directed into a new channel, and led me to a conclusion altogether unexpected, which I now submit, with due deference, to the consideration of the profession, as I feel myself compelled to adhere to it, notwithstanding my great unwillingness to interfere with the venerable teaching of the great Harvey, and to upset the accepted notions of the whole medical world. The conclusion, which I could not avoid drawing, is, that the two sides of the heart do not contract simultaneously, but in succession, the right preceding the left; and that the two sounds of the heart are produced not in any of the various ways which have been dreamed of by physiologists and practical medical men; but the first sound by the contraction of the right side of the heart, and the second by the contraction of the left side, so that the symbols, *lub dup, lub dup*, when truly interpreted, are simply *right left, right left*.



These views are borne out by the examination of the heart of a living animal, whether *in situ* or detached. The action of the organ consists in a series of tumultuous movements which are not easily followed by the eye from their rapidity and unsteadiness. The movement manifestly commences in the right auricle, and is propagated without a pause downward into the right ventricle. The whole organ is now raised with a rapid quivering movement, and this unsteady locomotion renders less distinct the contraction of the auricle and ventricle of the left side, which take place during the recession of the organ into its place. A period of rest now ensues longer than that from the beginning to the end of the movement. There is no interval perceptible either by the eye or by the ear between the contractions of the auricle and the ventricle of either side. The interval between the successive contractions of the right and left sides is readily perceived by the ear, but cannot be detected by the eye from the unsteady vibration of the whole organ. It may be inferred that the impact of the heart against the ribs concurs with the contraction of the right ventricle, and the pulsation of the pulmonary arteries; while the contraction of the left ventricle coincides with the pulsation of the systemic arteries. We are thus supplied with an easy method of testing this theory experimentally on a living animal; for if it be true, the pulse of the pulmonary artery must precede that of the aorta, and be separated from it by exactly the same interval that intervenes between the two sounds of the heart.

Whoever has had an opportunity of observing the successive contractions of the fibres of the dorsal vessel of a transparent worm, proceeding rhythmically from behind forward, and considers that the central organ of the human foetus was at one time just such an organ, and acted in precisely the same way, will find therein a strong analogical argument in favour of the doctrine that the same rhythmical mode of action continues unchanged in the perfect organ of the adult.

For the sake of those physiologists who are not physicians, and shut out from the rich store of facts which pathology reveals to us, and so are unable to verify for themselves the preceding observations, I mention an experiment which any one can make upon himself, but let him first be well assured that he has no undue tendency to disease in either lungs, heart, or brain. Let him blow out his breath as completely as he can, and then by a strenuous effort of will refrain from inspiring till his pulse becomes irregular, which it will do in less than half a minute, and continue feeble and irregular for some



time after. A young medical friend of my own, with a finely developed chest, excels in doing this, and terrifies the bystanders, as he once did myself, by saying that he could stop the beating of his heart; whereas, he merely disturbs the equilibrium between the mediastinal and pulmonary reservoirs, from which the supply of blood to the two sides of the heart proceeds.

