LECTURE

ON THE

CHARACTERS OF THE ARTERIAL PULSE,

IN THEIR RELATION TO THE MODE AND DURATION
OF THE CONTRACTION OF THE HEART IN
HEALTH AND DISEASE.

Delivered at the Royal College of Physicians, London.

BY

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PART II.

HAVING, in the Introduction, endeavoured to establish certain principles for the guidance of the clinical observer in the interpretation of sphygmographic tracings, I proceed to illustrate these principles by reference to cases; but, before doing so, would guard myself, as well as warn those who are looking hopefully to the sphygmograph as a new aid in clinical research, against the error to which our practical bias is so apt to lead us. The tendency to force theories to practical ends before they have had time to be established, is one of which we have many instances in the history of medicine. Let us remember that no theory ought to be applied to the issues of practical life, until it has been subjected to scientific criticism, and received as a scientific truth. Let us, therefore, avoid being in too great a hurry to introduce the sphygmograph into the consulting-room; for if, with so imperfect a knowledge as we at present possess of first principles, we endeavour to use those principles in diagnosis, we shall not only discredit ourselves, but the method by which we profess to be guided.

The practical information which will be eventually obtained by the use of the sphygmograph will clearly not differ in nature from that which we now obtain from the exploration of the pulse in the ordinary way. It is not likely that, with the one exception of certain aneurisms, the instrument will ever be of much use in the discovery of organic lesions. Its value will, in my judgment, consist in the exactitude and precision which it will impart to the notions we at present possess as to the practical significance of the various forms of pulse. Every one will admit that our knowledge of the pulse is in this sense so vague, that it is difficult to record it in words. In another, and more important, sense, it is exact; for he who has acquired the habit of discriminating pulses instinctively—a habit which, I apprehend, is a great deal more rare now than it used to be—instinctively learns valuable truths from it, which he can apply to practice. Yet how difficult—how impossible—is it for the skilled physician to impart this knowledge to his less experienced junior! How difficult to describe to the student what you feel when you place your finger on the wrist! How infinitely more easy, for example, is it to describe a *bruit* or a friction-sound, and to make either of them clearly understood, than a pulse; how inconsistent are the classifications of pulses found in text-books, and how various the opinions given by different physicians as to the same pulse!

That the use of the sphygmograph will tend to clear up all this uncertainty, I can entertain no doubt; for, whatever else may be questioned, it cannot be denied that it is an impartial and consistent witness. Notwithstanding the infinite variety of form observed in different persons, the tracing of the pulse of the same person is the same at all times so long as he is in health. The normal succession of events is so constant, that every departure from it affords evidence of disease.

The conditions of the circulation which manifest themselves in the pulse, independently of organic changes in the heart or arteries, are, as has been already stated in the introduction, those which relate principally, either to the mode in which the left ventricle contracts—whether sudden or gradual, or to the relative quantities of blood contained in the arteries and veins. I will endeavour first to give examples of those forms of pulse in which the arterial pressure is defective. Be it remembered, that it is the function of the heart to fill the arteries and empty the veins; that, in proportion as the energy of the heart diminishes in disease, the veins become fuller and the arteries emptier; that all modes of death, excepting death by syncope or shock, consist in gradual depletion of the arteries; and that, in almost all fatal disease, the signs which indicate the tendency to a fatal termination are those which imply sinking of arterial pressure and increased distension of the veins. In

health, the arterial pressure is such as to balance a column of mercury six or seven inches in height; but, even with a pressure of one or two inches, the circulation may be continued for a long time. It is only when it sinks to zero that systemic life is extinct.

In those diseases in which the powers of life ebb gradually away, the pulse assumes, during the last stages, a form of which examples are given in the figs. 7 and 8. This form denotes that the exhausted heart

Fig. 7.—Pulse of exhaustion.
J. E., aged 38.

Fig. 8.—Pulse of exhaustion with excitement. M. O., aged 61.

is no longer able to maintain the normal difference between the arterial and venous pressures,* so that, by the increase of the one and diminution of the other, they approach each other more and more closely. In both of these cases, the volume of the heart was known during life to be greatly increased, while in one of them (No. 7) a loud and harsh systolic murmur was heard over the præcordia, which was supposed to indicate disease of the mitral valve. In both, the superficial cervical veins were distended, and pulsated visibly. After death, it was found that the left ventricle was hypertrophied and the right cavities dilated, and that the abdominal organs exhibited those evidences of venous congestion which are usually associated with so-called obstructive disease of the heart. A pulse of this kind is truly described as weak or failing. It often seems to vibrate under the finger a character which is due to its double beat. The primary expansion is so feeble, that it is not transmitted so far as to the wrist, but can be readily demonstrated by applying the sphygmograph to the femoral artery at the groin.

Sometimes the second beat is so well marked as almost to equal the first in intensity. The explanation of this fact, which depends on the elastic resistance of the arteries, may be thus stated. So long as the vigour of the cardiac systole remains unchanged, the greater the elastic resistance, the less is the disturbance of pre-ure-equilibrium produced by it. In other words, when the arteries are relatively tense—i.e., tense as compared with the force with which the heart contracts, the vascular distension at the moment of systole is equal throughout the whole system, and its subsidence is continuous and unbroken, as in the normal state of the circulation. If, on the other hand, the arterial resistance be feeble, the immediate increase of tension is not only slighter, but more partial—being much greater in those parts of the system which are nearest the heart than in those which are more distant. By following out these considerations, we arrive at the general principle, that the greater the inequality of tension produced at the moment of the contraction of the heart, between the peripheral arteries and the great trunks, the stronger is the second beat as compared with the first. It will be understood that this explanation, which is the same in substance as that which I gave more generally in the introduction, is applicable to every case of diastolic murmur.

Fig. 9 is the pulse of a man of 25, convalescent from an attack of pneumonia. It is the pulse of mere arterial atony, such as is commonly met with in healthy persons after recovery from acute diseases. During his illness, the pulse of this patient had assumed a form analogous to fig. 10, but of much greater frequency.† The pyrexial sharpness with

Fig. 9.—Pulse of convalescence from acute disease. S. J., aged 25.

Fig. 10.—Pulse of nervous excitement. W. H., aged 12.

which the heart contracted, shewed itself in an excessively sudden increase of arterial tension, which, in consequence of the great yieldingness of the arteries, was of short duration. The closure of the aortic valve was immediately followed by a diastolic wave of great intensity; with reference to which it was interesting to notice that, in this as in all other instances in which I have had occasion to make the observation, the pyrexial acceleration of the pulse was not attended with any change in the duration of the systolic period—that is to say, the heart beat more frequently, not because its movements were more quickly performed, but it took a shorter time to repose between them. The time intervening between the first and second beat, the shock and the counter-shock, re-

* It is usually estimated that the pressure on the arteries in health is about twenty times that which exists in the veins.

† See, in further illustration, Fig. 6.

remained the same, although at one time the pulse was at 70, at the other at 110. Whether the emptiness of the arteries in convalescence depends on diminution of the mass of the circulating blood (spanemia), or on relaxation of the capillary arteries, either of which would serve, on purely physical principles, to explain it, is uncertain. I am inclined to attribute most importance to the latter.

I refer to pulse No. 10 principally for the purpose of shewing how completely the sphygmographic form may be modified by merely functional, that is to say nervous, disorder; and particularly how impossible it is to discriminate between the effects of mere nervous excitement of the heart and that which accompanies pyrexia. It is the pulse of a young man aged 18, who, although he had neither lost flesh nor strength, yet, on account of a slight cough, imagined himself to be consumptive. So far as relates to its form, it can hardly be distinguished from the more frequent disordered pulse of pneumonia, which is represented in Fig. 6. In both cases, if the view which I suggested in the introduction be correct, the *suddenness* of the contraction of the heart indicates its spinal character, although the part which the nervous centres take may be different.

Fig. 11 represents the pulse of a middle-aged man recently under the care of one of my colleagues at Brompton, who had acute rheumatism eight years ago, and several times since. When the tracing was taken, he was suffering from extreme orthopnea and præcordial pain. The impulse of the heart was to the left of the mammary line, and occupied a space as large as the palm of one's hand. A loud diastolic *bruit* was heard at the fourth cartilage, and a systolic bellows-sound over the aorta. Posteriorly, there were dulness at both bases, and abundant sub-crepitant *râles* in inspiration. There could, therefore, be no doubt as to the nature of the case, which soon terminated fatally. After death, it was found that the aortic valve was so altered that the most copious regurgitation of blood must have taken place during each diastolic period. In this case, the pulse exhibits characters which, I believe, are not met with excepting in connexion with aortic incompetence. These do not consist, as is often supposed, in the unusual verticality of the expansion; for, as has been already seen, this peculiarity may be produced by merely functional disorder. The distinctive peculiarity consists in the collapse. The tracing shows that the artery becomes completely emptied during the interval between each beat and its successor; so that the diastolic expansion is no longer indicated. The explanation is simple. Immediately after the heart has ceased to contract, the blood injected into the aorta rushes back into the relaxed ventricle; so that, although the arterial equilibrium is for a moment disturbed, it is almost immediately re-established, the excess of pressure in the great arteries being at once relieved. In other words, the elastic force, which is naturally expended in producing what is called the diastolic expansion, is wasted in regurgitation.

Fig. 11.—Pulse of Aortic regurgitation. H. R., aged 36.

Fig. 12.—The same. H. K., aged 38.

The next case (Fig. 12) is that of a man of similar age, who in like manner had rheumatism about fifteen years ago, and several times since, but did not suffer from disease of the heart until his last attack in August 1866. The præcordial dulness in this case did not extend beyond the mammary line. The impulse was diffused and expansive, and ended in a sudden retraction of the wall of the chest, easily felt by the hand. A diastolic *bruit* was heard at the fifth left cartilage, and a systolic *bruit* in the arteries, just as in the previous case. The tracing indicates that the primary expansion of the artery was sudden and excessively violent; and the collapse so complete, that the second beat is only slightly indicated. In such a pulse, one might imagine that the artery was entirely empty during the pause of the heart; but I have found that, by weakening the spring of the sphygmograph, I could obtain tracings in which both the second event, of which the diagram gives no indication, and the diastolic collapse, are expressed.

[To be continued.]

CHOLERA IN BHOOTAN.—Cholera in a most virulent form is said to have broken out in Bhootan, as well as in the Terai, and to have caused a large number of deaths.

THE THRUSTON SPEECH

UPON

THE PROGRESS OF MEDICINE DURING THE LAST THREE CENTURIES.

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EVERY age has had its peculiar taste and fashion. The same sciences have seldom been cultivated for a length of time with the same degree of ardour; they have given way to others; and all, during these transitions, have experienced changes more or less favourable to the improvement of their systematic arrangement. Medicine, at different periods, has assumed the tone of the prevailing sciences; it has ever endeavoured to speak their language, and to subject itself to the same rules; so that it has passed successively through all the different systems that have acquired any degree of celebrity in the world. Of such changes, one of the most notable occurred near the beginning of the sixteenth century, when, by the sudden and extraordinary impulse given to chemistry, the character and complexion of medical speculation was entirely transformed. It was, at this time, that inquirers first began to speculate, who believed in the transmutation of the base metals into gold, and in the existence of a something, could it but be found, which had the power of prolonging life to an unlimited period. In the researches to gain these objects and secrets, many valuable facts and principles were incidentally unfolded, many of Nature's laws were fortuitously established. While chemistry was thus progressing into the condition of a science, Hippocratic and Galenic medicine, or the doctrine of humours, began to be less practised, and the chemical mode of reasoning on the operations of the living body, and the application of chemistry to medicinal composition, came to be very generally admitted.

The benefit, however, which was conferred upon medicine by the labours of the chemists was trifling and uncertain, compared to the great and direct advance which was produced by the researches of the anatomists. Some attention had been given to the structure of organised bodies by the earlier Italians; and they had even ventured, in a few instances, to dissect the human subject. Nevertheless, scarcely any discovery or any improvement worthy of notice had been made for many ages, when Vesalius, about the middle of the sixteenth century, entered upon his career of inquiry, prosecuted his examinations with unwearied diligence, and, disregarding the obloquy that was piled upon him, succeeded in publishing an anatomical work, which, at this day, is regarded with admiration, and which maintains its character as a faithful transcript of Nature. Anatomy, being a science more immediately dependant upon the accumulation of matters of fact, hereafter advanced in rapid strides. The investigations extended to every portion and structure of the body. The labourers were rewarded by many grand discoveries. Foremost was that of the circulation of the blood, first completely demonstrated in the year 1620 by our distinguished fellow-collegian, William Harvey.

It might have been conjectured that, from this time forward, medicine, commencing as it were from a new starting point, would have regularly, if not rapidly, proceeded on to a state of comparative perfection. But, no; this new instrument of truth was destined to become a new excitation of fanciful and futile hypotheses. As the chemists had derided the Galenic faith, so the chemical era, in its turn, gave way before the doctrines of the mathematical physicians, as they have been termed. Nothing now was thought of but hydraulic motion and calculation of forces. How far from truth some of the inferences were respecting the same particulars, may be inferred from the vast difference in the deductions broached by different theorists; for, while the force of the heart was estimated by one at a few ounces, it was calculated by another to be many pounds.

Through the succession of these diverse doctrines, disease was alike supposed to take its origin from the fluids of the body. This supposition continued to be accredited until the beginning of the eighteenth century, when the celebrated Boerhaave initiated the adverse. This individual, like the eclectics of old, aimed at incorporating with his own