The Harveian Oration to the Royal College of Physicians (on Harvey's experiments which led to understanding of blood circulation), written by Dr. Edmund Alexander Parkes, FRCP, FRS, and read after his death

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THE HARVEIAN ORATION

1876.

EDMUND A. PARKES.

Presented by

Dr. J. C. Parker.

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BY THE LATE

E. A. PARKES, M.D., F.R.C.P., F.R.S.

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THE following unfinished Oration, written by Dr. E. A. Parkes, was read before the President and Fellows of the Royal College of Physicians, on June 26th, 1876, by Sir William Jenner, F.R.C.P., at the request of Sir George Burrows, Bart., President of the College at the time of Dr. Parkes' death.

THE

HARVEIAN ORATION.

Sir,—

On the statue of William Harvey which was erected by his contemporaries of the College of Physicians, and which was burnt in the great fire of London, was an inscription "viro monumentis suis immortali." In these days, when discovery succeeds discovery so fast that it taxes the memory to remember the discoveries, much more the names of the discoverers, it may be asked, Can we call any memory or any works immortal? Some few names in literature, some few in philosophy, and some among those who have founded or destroyed empires, have echoed down the stream of time for a thousand or may be

two or three thousand years, and have thus secured what we call immortality. But will William Harvey be admitted into this scanty band? A thousand years hence will there be, in this city, an Harveian orator standing before the great physicians of those days, and proclaiming still the immortal name of the discoverer of the circulation of the blood? It may seem rather too curious thus to endeavour to anticipate the verdict of posterity, but it is only when we put the question in this way that we get the measure with which this discovery must be meted. Is it pure gold? does it stand the fire of the assay? will time bring no dimness upon it, nor eat into its substance and transform it into dust? The answer I believe must be that the explanation of the actions of the heart and of the circulation of the blood is not only one of those cardinal discoveries which lie at the very foundation of physiology and medicine, but is from its very nature one of those great landmarks which must remain in the sight of all. The full interpretation of this

great discovery is even now not given, for we are still painfully learning what the blood does in that marvellous circuit which never ends, yet ever recommences. The discovery can no more be overlooked or passed by in physiology, than the movements of the world round our sun, and of our sun round some great centre, could be overlooked in the investigations of astronomy. We may then, I think, confidently assert that this discovery is what we call an immortal one—that is, that it is too great and too momentous to permit men to let the name of the discoverer fade from their minds.

The oration which I have the honour to deliver to-day was not originally intended either to celebrate the discovery of the circulation or the name of the discoverer. It was, in fact, instituted by Harvey himself, and was intended to recall to the memory of the Fellows of the College of Physicians the names of the benefactors who, in their day, had done the College good and true service, and to exhort the members of the

College to study and search out the secrets of Nature by way of experiment. And it may be hoped that in years to come there may be many names and many memories which will be recalled in this hall and on this anniversary, and that other discoveries, if not so splendid as that of Harvey's, may still be enumerated with pride by successive Harveian orators. But on the present occasion I propose not to pass beyond a theme which has had for me a powerful attraction. When any one examines into this discovery of Harvey's, and gradually recognises its extraordinary importance (for the full sense of what it is grows upon him as he studies it), he cannot but be seized with an urgent wish to know how the mind which solved so great a problem was constituted ; how it worked, and how it reached, not merely the probability, but the certainty, of a grand natural law. The proof of the circulation of the blood was a discovery in the truest sense of the word. There was no accident about it—no help from what we call chance; it was worked out and thought out, point

after point, until all was clear as sunshine in midsummer. Nor had it been anticipated. Harvey himself states quite candidly and truthfully how opinions stood before he published in this College his evidence on the motion of the blood. Men for years had perplexed themselves about this problem. Now one guess, now another, may have hovered for a moment near the truth ; but, as Dr. Rolleston has so well shown in a former Harveian oration, there cannot be for a moment a doubt of the entire originality of Harvey. As he claimed for himself, so we can most justly claim for him that he "was the partisan of truth alone," and truth would have been shamed if he had robbed the least of his predecessors of a single grain of the discovery.

What, now, was the intellectual calibre and tendency of Harvey's mind as far as we can judge of it from his works ? He appears to me to have had in a marked degree what is sometimes called the "scientific mind." But this term is not, I think, a good one.

Some men who have nothing to do with science have a mind like Harvey's; there were examples of it in pre-scientific days, and though it may be more common in our time, it has existed always. Nor is the term otherwise a correct one. Men of great mathematical insight must be called pre-eminently scientific; but the scientific mind to which I refer is not mathematical in the highest sense of the word. Harvey was one of those men who are urged on to submit everything to experiment and observation. As he himself says (I quote, of course, from Dr. Robert Willis's admirable translation), "he professed to learn and teach anatomy, not from books, but from dissections — not from the positions of philosophers, but from the fabric of Nature." And in his introduction to his work on Generation, where he has a chapter on the "Manner and Order of acquiring Knowledge," he says, among other sentences to the same purport, that "all true science rests upon those principles which have their origin in the operation of the senses; and

that no one can truly be entitled discreet or well-informed who does not, of his own experience, from repeated memory, frequent perception by sense, and diligent observation, know that a thing is so in fact." And in another place he says, "Nature is herself to be addressed; the paths she shows us are to be boldly trodden; for thus, and while we consult our proper senses, from inferior advancing to superior levels, shall we penetrate at length into the heart of her mystery."

It may be said that a mind of this kind, the main character of which is a habit of diligent observation of Nature, presents nothing unusual, that all men have it more or less, and that we cannot make this habit or power a means of classification, or partition out an order of minds by what is a common possession of all minds. My contention is, however, that some minds possess this power and intentness of observation in quite an extraordinary degree, so that it really does separate them from other men. A parallel case may be found in music.

All men have some musical power, but every now and then a man is born with such an extraordinary genius that he is quite lifted out of the crowd of common musicians. Mozart was at five years of age trying to compose a concerto for the harpsichord, and at eight years composing six sonatas which were good enough to be published ; Mendelssohn at twelve conducting his own operas ; Beethoven deaf, yet knowing how to harmonize and combine the notes of diverse instruments not one of which he could hear. All these and many others are examples that an universal faculty may rise into a region which seems above common humanity. In the same way poets are truly said to be born, not made, for admitting all the power of education, when we see that scarce ten centuries can claim an epic, we cannot but doubt whether education alone will ever elevate the poetical faculty, more or less possessed by all men, into those splendid examples which the names of Homer, Æschylus, Dante, Milton, or Shakspeare recall. And

so also there appears to me a mind with quite peculiar mathematical insight. When Newton first read Euclid it seemed a well-known road to him; his apprehension of the demonstrations which ordinary men take so much time and trouble to learn, was so quick that the whole field of geometry unrolled before him almost as if he had a prior knowledge of it. But there was nothing in the nature of Newton's mathematical insight which was different from that of other men; it was merely that the extent and power of that part of his mind (as well as other parts) was so wonderful.

In the same way it seems to me that there is a mind pre-eminent in its power of observation and in its recourse to experiment. When it exists it gives us the great naturalists, and chemists, and physiologists of the time. Let any one call up to his memory men whom he knows, and who are the acknowledged masters in Botany, or Zoology, or Chemistry, and I think he will admit that these have quite unusual powers

of close observation and appreciation of natural phenomena. Here, again, it is power possessed by all men, but in them carried to an extreme. When, as in Newton, this observing or experimental power is combined with mathematical insight, we get a philosopher of the highest class, who writes his name indelibly on the record of Science.

Now, I claim for Harvey a position among the men exceptionally gifted with these powers of observation. There is in his works on Circulation and on Generation quite sufficient proof of this, and I shall give some evidence as I proceed. Men possessed of this power seem to be unable to avoid exercising it. They must observe, must try experiments, must, to use Bacon's phrase, be always asking questions of Nature. In the Middle Ages, to "put a man to the question" was to torture him into an avowal of the truth, and in this sense Harvey may literally be said to have tortured Nature. He was a thorough vivisectionist, and animals of all kinds ministered to his insatiable curiosity. He owns to

having used a "variety of animals," whose living breasts and pericardia he opened, and if he had lived in these days he would, perhaps, have met with scant mercy from a Royal Commission on Vivisection. And yet, without that, would the circulation have been discovered? But the work on Generation shows even still more his power of really intense and continuous observation. What marvellous industry and indefatigable search after facts! And this disposition must have commenced extremely early, for he had made all his numerous experiments on the circulation before he was thirty-seven, and must have lasted to extreme old age, for he was still observing the movements of the stars or the growth of plants up to the time of death, when he was nearly eighty years of age. A usual peculiarity of this class of mind is the great ingenuity and imagination men show in arranging their experiments and in devising new ones. Every one must have admired the ingenious mechanism by which physical hypotheses are tested or proved; we may

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see a great chemist not only devising very complete apparatus, but getting at the composition of bodies in the most roundabout ways by substitution or residues, so that one is doubtful which most to admire, the marvellous result or the skill which has attained it. There is not much trace of this in Harvey's works, for the subjects perhaps hardly admitted it; he was an anatomist and naturalist, and had only to procure his animals and to make his observations, but there are some parts in his writings which prove he could have shown ingenuity had it been wanted. Yet on the whole I should say he was not an imaginative man, and when Dr. Willis calls him so because he uses some poetical expressions, the fact is overlooked that such expressions are merely the result of culture. Imagination is shown in other ways, and there is little trace of it in Harvey's writings; he bent his mind on the thing before him, and he kept it to objects of sense, and did not attempt, perhaps would not attempt, any flight which led him from the earth, except,

perhaps, when, by long dwelling on the impenetrable mysteries of generation, he allowed his mind to wander a little from the phenomena to their hidden causes. He possessed, however, in a very marked extent, one character of the class of minds to which he belonged. He had faith in facts. Now this may seem a common matter, but it is not altogether so. Many observers have a great mistrust of the facts they have themselves discovered. They are biased by previous theories, they do not see how their new facts fit in, they think there is some mistake, or they do not really fully see what they have seen. At any rate, they explain away what seems to them strange and unlikely, and really modify or alter what they have found. They are, in fact, honestly untruthful. Harvey was quite otherwise; when he had seen and touched, so to speak, a fact, and knew it was so, he accepted it, no matter how it struck on previous knowledge. To this clear truthfulness he owed his great discovery. I will only refer to one example of what I mean.

After he had made out the actions of the heart he fell at once upon the problem of the total amount of blood, and tried to determine this in animals, such as sheep and dogs. He then made out the capacity of the ventricles. In man he found the left ventricle would hold two ounces of blood; now his difficulty was to know how much it propelled into the aorta at each contraction, and I imagine that he did not succeed in doing this to his satisfaction, as he gives no experiments on the point. But he says, "Let us suppose, as approaching the truth, that a fourth, fifth, or sixth, or even but the eighth part of its charge is thrown into the artery." Then, counting the pulse, he shows that in half an hour far more blood must pass through the heart than all the blood in the body. In the case of the sheep he says that if only one scruple passes at each contraction, in one half hour 3½ lb. would pass, but the sheep's total blood is only 4 lb. But it is obvious he had a still clearer idea of the great

velocity, as he takes the very lowest discharge he can conceive—namely, one scruple, so as to be within indisputable limits. But when he had taken his higher limit, he calculates that if the amount be half an ounce, not less than 41 lb. 8 oz. would pass through in half an hour; and if it be one ounce he says the quantity would be 83 lb. 4 oz. He leaves, however, the actual amount to be hereafter settled by the experiments he has made, he says, with reference to this point. Now, even with the conviction of the truth of the circulation, he may well have been staggered at this enormous velocity. But he does not hesitate to accept the result. We now know the circulation is much quicker even than this last. Think how many men, when they got a glimpse of this rapidity, would have said, "That is impossible; there is some blunder." Harvey kept to his facts, and had faith in them, just as Edward Jenner, hearing the story that hundreds had heard before him, and had

made no use of, had faith in the fact which has given to mankind the power of controlling small-pox.

In consequence of this faith in facts he overlooks none ; he passes by none. Now a common error is to think some facts more important than others ; but all are important, and if one is left out, a whole heap may fall asunder. Now Harvey omits nothing ; he commences with the most obvious, and proceeds step by step ; nothing is blurred ; nothing is left ill-defined. His work was composed before the Novum Organon was published, but it has been well said by Willis that it might have been planned on the model of that system.

The marvellous clearness of Harvey's treatise on the Action of the Heart and Circulation is quite unsurpassed. It is said that not one of his hearers at this College ever doubted his doctrine, and we can well imagine this when we see the way in which the facts are laid in order ; first this, then that, then a third, and so the mind is led from step to step until the

whole is seen clear as daylight. The opposition he met with came from outside, and from abroad, from those who had probably never read his lucid and convincing work. Happily, this College is free from the least suspicion of opposition; it honoured his doctrines when he proclaimed them living, and his memory when his written word alone remained.

Such was the mind, then, so gifted with the highest observing power, so true to what that power saw, so clear in stating what was seen, which made this immortal discovery. And now I think, if my conception of the mind is a true one, we can see clearly how the discovery was made.

Harvey was twenty-four years of age when he returned from Padua. He had no doubt had his attention strongly directed to the subject of the motion of the heart by his teacher, Fabricius. He found everything obscure, and determined, I presume, at that time, to work at this problem. He desired, to use his own words, "to contemplate the motion of the heart and

arteries not only in man, but in all animals that have hearts ; and, further, by frequent appeals to vivisection and constant ocular inspection, to investigate and endeavour to find out the truth." He nowhere gives a complete list of the animals he employs. He mentions, as it were incidentally, dogs, hogs, sheep, birds, fish, eels, snakes, lizards, toads, frogs, crabs, shrimps, snails, shell-fish, bees, wasps, hornets, flies. He laid all the kingdom of Nature under contribution, and sacrificed hecatombs of victims. He went still further. Directed to it by a remark of Aristotle, he commenced the study of the development of the fowl in the egg, and also examined the fœtus in man and animals.

At first he tells us that all was obscure, and he found the task so difficult that he was tempted to think with Fracastorius "that the motion of the heart was only to be comprehended by God." But at length, by constant looking and watching, the thing became clear. He disentangled one movement from another, arranged them in

time and order, and at last arrived at so perfect a knowledge of the intricate movements of the heart that he left really nothing for his successors to do. That formed, then, the first part of his great work, and gave the first words to its title, "De Motu Cordis."

No doubt years had passed before he had made all this out. Engaged in practice, married, and a few years later becoming physician to St. Bartholomew's Hospital, he can have had but little time for these researches.

At length, all was clear about the heart, and he had, in addition, carefully determined the total quantity of blood in the body of animals. He had also found out the action of the cardiac valves, and was acquainted with the valves in the veins; and now there came the next step. He nowhere precisely tells us, but he seems to have kept the whole facts before him, just as Newton tells us he did with his great discoveries, until light began to dawn. To us who are so familiar with the circulation

of the blood, it may seem strange that Harvey, having solved the mystery of the heart's action and of its valves, being certain that the blood poured out by the aorta and pulmonary artery, and flowed in by the vena cava and pulmonary veins, should not have come at once to the idea of the circulation. But there were, perhaps, two causes which held him back. We must remember that there were no microscopes to demonstrate the channel of communication between arteries and veins; and of course he had no true conception of the immense capillary system. Then, even with a mind of such a class, it is impossible to put aside the influence of previous teaching. The power of the general opinion must impress every man, and lead him to see difficulties which are perhaps unreal. Harvey had very soon dismissed the absurd notion that there were invisible pores in the septum of the heart; but he appears to have been seriously hampered by the Galenic doctrine of the blood being supplied at once by the food. But at length

he says: "Not finding it possible that this (that is, the quantity of blood) could be supplied by the juices of the ingested aliment, without the veins, on the one hand, becoming drained, and the arteries, on the other, getting ruptured through the excessive charge of blood, unless the blood should somehow find its way from the arteries into the veins, I began to think whether there might not be A MOTION, AS IT WERE, IN A CIRCLE."

Here then, at last, was his great discovery made. I entirely agree with the Harveian orator of last year, Dr. Guy, that Boyle's story of Harvey being led to his discovery by considering the action of the venous valves, is incorrect; that would have been merely a lucky guess from one fact, not an induction from a great many. His next proceeding is most characteristic of Harvey's character of mind. To most of us, I think, if the movement of the blood in a circle from arteries to veins had occurred, the conclusion would at once be that it so completely accorded with all facts

that it must be so. We should be tempted to call out "Eureka" like the sage of old. But Harvey's first thought was simply how to completely test and thoroughly prove this idea. He did not at once accept his own conception of motion in a circle, but tested it by experiment; for, says he, "I *afterwards* found it to be true and finally saw" that the blood was distributed in such a way. In fact, he put his own hypothesis into the assay, and proved its truth so clearly and by such able arguments, that even at the present day any one wanting to prove the circulation of the blood (microscopic observations and fine injections not being used) must adopt Harvey's method In fine, he brought his doctrine to demonstration, and proved it once for all; and, throughout everything was done by observation and induction. There is no theorizing, no useless attempts at explanation, no employment of imagination, no guesses at truth; all is fact arranged in order and leading slowly but certainly up to certain truth. Then the

title of his book was complete, "De Motu Cordis et Sanguinis," and it was published in 1628, though since 1616 he had yearly demonstrated its truth before this College. Everybody, in reading Harvey's works, notices the extreme modesty with which he announces his discovery. The simplicity and the entire absence of self-applause are most remarkable. The clearness of the style, the careful avoidance of ambiguity of expression and its brevity, make it indeed a model for all time of a philosophical treatise.

The other work of Harvey's which in part remains to us is the treatise on Generation. Harvey was evidently led, probably by the teaching of Aristotle and of Fabricius, to watch the development of the embryo in the fowl's egg. Probably he may have thought by watching the punctum saliens he would gain some insight into the problem which so long occupied him. But very soon he must have pursued the subject of generation for its own sake, for it formed the study of all the latter part of his life.

He had completed a work on the generation of insects, the loss of which during the Civil Wars caused him great regret, and this and his remarks on the interest Charles I. took in his researches on the generation of deer, show he must have been busy with the subject. Very early during his connexion with the Court he had obtained leave from Charles I. to dissect the does killed in the hunts of which the king was so fond, and he interested Charles himself in the subject.

During the occupation of Oxford, where he remained for some time, he continued his observations on the chick, and in 1650, when he was seventy-two years old, Sir George Ent tells us he was still engaged with the subject. In that year Sir George Ent obtained from him the MS. of the treatise on Generation we now have. He can hardly have studied the subject for less than thirty years. It appears, indeed, to have had for him the same fascination it has had for all physiologists who have attempted this difficult problem. Harvey

was less successful with it than he had been with the circulation of the blood. He brought to bear on it the same patient observation and unwearied industry, the same keen insight and unrivalled power; but he was in face of an inscrutable mystery. What he did and how clearly he saw, as far as the light of those days permitted, has been admirably brought before this College by a former Harveian orator, Dr. Farre, who speaks with an authority on this subject second to none in this country. I shall not, then, venture to repeat what has before been so well said. I will only remark that Harvey seems to me to have clearly caught sight of the mystery of generation, which we, with all our better powers of inquiry, are just as much unable to solve. How it is that two minute cells, each so fragile that if removed for a few minutes from the conditions which surround them they die, how it is that these minute and apparently inert cells should meet and then should give rise to the most wonderful power we can conceive, is as dark a problem to us as to

Harvey. We see it everywhere, in the vegetable and in the animal kingdom: suddenly from the contact of two cells of opposite sexes a formative power, as Harvey calls it, arises. The mother cell acquires in a second entirely new powers—it grows, differentiates, produces layer after layer, organ after organ, and all with a most wonderful regularity as to time and order, which holds good age after age in the different species of vegetables and animals. At length arise not only the wonderful machinery of the animal body, but the mind, which tries to investigate its own extraordinary action.

All attempts to explain this are mere concealments and subtleties of language. Harvey himself abandons in some degree his hold of facts, and looks upon the influence of the male cell on the female as a sort of "contagious effect," which he refers to in his treatise on Conception as accomplished by "atoms, odorous particles, fermentation, or anything else—even something immaterial." But the giving this

name to the fact brought him no nearer to an explanation, but even confused it more. He was, in fact, at an end of the means of observation which were possible to him. He had no microscope to carry him farther, as it has done us; though the only effect has been to throw the inscrutable a little back.

It must be said, however, that injustice is done to Harvey if we do not remember that his treatise on Generation is an incomplete work. He had lost the part on Insects; and he also evidently regarded the work we now possess as the commencement only of a complete treatise. Without dwelling further on this great work, I think it may be said that, baffled as he was in his search, it yet shows Harvey's wonderful power of observation as conspicuously as the treatise on the Circulation.

The mention of the loss of the treatise on the Generation of Insects may remind us that other works of Harvey's are lost which would be to us of inestimable value. In his second disquisition to Riolanus he

refers to a work on "Medical Observations and Pathology," which, he says, will throw light on many diseases, and will show, "how speedily some of these diseases that are even reported incurable are remedied and dispelled as if by enchantment." This work is lost, or if it exists . . . .

With this broken sentence the oration ends, and with it the last literary effort of Edmund Alexander Parkes.

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