

THE
HARVEIAN ORATION,

DELIVERED AT THE
ROYAL COLLEGE OF PHYSICIANS,

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BY
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MR. PRESIDENT AND FELLOWS,

We meet here to-day to commemorate the name of Harvey. It is fortunate that the College has prescribed no rules and framed no restrictions as to the mode in which we celebrate this anniversary, but that its Fellows are left to refreshen his memory from springs of every source, hoping thereby, to derive some new inspiration from the contemplation, during a few minutes of the year, of one whom they may almost call their founder. Each Fellow may, therefore, in turn, endeavour to expound his theme in the manner which is most befitting his own powers and inclinations. Thus, at one time, we have pourtrayed before us the personal history and living picture of Harvey, at another, an exposition of his great discovery, and at another time, as at our last anniversary, we have a discourse by one of the

most distinguished physiologists of our College, showing the relation of his discovery to the knowledge of the period and to that which succeeded it. I dare not attempt to improve on these well-exhausted themes, but falling back on the object which Harvey had in view, in wishing to perpetuate the remembrance of this day, I find that I have a text sufficient for me. I need not remind you what his object was, since Harvey's injunction to the College is ever before us, "to study and search out the secrets of nature by way of experiment." Let this then be my theme—That we members of this College, practising physicians like himself, should occupy ourselves with the investigation of nature. Harvey could not have had in contemplation all departments of natural history, but only those which pertained to man or, as we may say, animal life. His wish was, that his followers should continue in the path which he had indicated, and that they should remember that one of their duties was the acquisition of further physiological knowledge. I ask, have his precepts been followed and his hopes been fulfilled? The answer is before us. We need but look through the long roll of our College, lately

published by our learned librarian, to find it. In that goodly list will be seen the record of the work performed by our members, some of which may bear comparison with that of the master himself. Much of course may be regarded as a mere drop in the great ocean of knowledge ; some, however, of the work contains great and elementary truths which eclipse all beside them—fundamental truths which immediately swallow up or form a culmination to the teaching of centuries, and cause mankind to take one long stride in the path of knowledge. Although it may be true that this great edifice of science which is slowly growing up before us, is one on which comparatively few Englishmen have laboured, yet they have been skilled workmen and have laid some of the weightiest of its foundation stones. Amongst these is Harvey, whose pedestal may be placed by the side of that of Newton, a man whom we justly regard as the father of English scientific philosophy. I need not specify the well-known names on our list, but cannot refrain from speaking of Marshall Hall and his great discovery, which may, in the future, be ranked in importance equal to that of Harvey's. His, like Harvey's, was not the discovery merely of an

isolated fact, but the full disclosure of the mysteries of the nervous system which had hitherto been unrevealed to us. His discovery had, as has been lately declared, the character of a first essential and fundamental principle.

Does not this contemplation of Harvey, instigating us to further discoveries in the animal organisation, accompanied by the thought of the glorious results which have followed his instructions, inspire us with loftier notions as to the nature of our calling? What means the existence of this College, and what is the function of its members? It were a trite and easy answer to declare our final aim to be the alleviation of the woes of our fellow creatures, and certainly this is all the public voice demands, but Harvey declares this end cannot be obtained without knowledge and, therefore, one of our duties is to search out the secrets of nature. Now how is this to be accomplished? It may be done either by direct experiment or by other means, with which I have little doubt Harvey was acquainted, that is, by making use of the experiments performed by nature herself in the various maladies which daily come before us, and by taking advantage of the vast

opportunities thus afforded of unlocking her secrets. Indeed a large part of physiological discovery has been made and must be made by the practising physician. Herein lies the scientific aspect of the medical profession which can never be understood by the outer world. We are necessary to the public for one object only—to treat and alleviate human suffering; that is the beginning and the end of medicine in their eyes. An opportunity has lately occurred by which we have been enabled to ascertain the opinion of the public as to the office of the medical practitioner. In their advocacy of the fitness of women for our profession we have heard the voices of eminent statesmen, of bishops, and even of the judges of the land, and they all agree in the sentiment expressed by one of the most distinguished members of their several bodies, that for the administration of medicine, the hand of woman is much more fitted than the hand of man. Beyond this sentimental conception of the medical profession, no shadow of a thought seems to have crossed their minds that the administration of drugs was not the physician's supremest aim. Let us, therefore, who take a larger view of our calling

express a hope that the other sex, when they have entered the portals of the profession, will rise out of the narrow sphere to which their best friends have consigned them, and by the display of a superior intelligence, convince a wise legislature, which has seen fit to grant them the privilege of practising medicine, of their capability of also giving a vote in the election of their supporters in Parliament.

Harvey says that we must always be acquiring knowledge, and surely the medical man, with his fellow-creatures before him presenting various states of organic and functional derangement, has problems relating to the working of the complex machinery of the human body, ever awaiting his solution. He, rather than any other member of the community, can appropriate to himself the words of the Latin poet—

“*Humani nihil a me alienum puto.*”

It is true that a knowledge of the structure and functions of the human body ought to precede that of its derangements, and, as a matter of instruction and discipline, we do so place it, but in our present state of comparative ignorance the

study of the two branches must be pursued together, for the very derangement of parts gives a clue to their uses. I say that the daily task of the physician is one of physiological investigation, as well as the treatment of disease ; for while affording relief to the sufferer who has sought his aid, he yet makes use of the opportunity to watch the effects of the quickened revolution of the wheels, of the stiffened valves, or the changes in the fluids which are circulating through the tubes of the animal machinery. I remember some years ago a meeting of physiologists was called, I believe in Germany, to discuss the propriety of altogether divorcing their subject from medicine, but it was found that the attempt was impossible, for though it be true that physiology may be studied apart from any connection with our medical art, yet the chief of all animals, man, in whom the greatest scientific interest centres, is so prominently placed in his disordered states before the physician, that the experience of the latter cannot but assist in the work of the physiologist. Moreover, in the application of his art—in the use of drugs, many interesting and important facts are acquired bearing on the

function of the organism. Just as the pure physiologist makes experiments in his laboratory in order to discover the function of some portion of the animal economy, so the physician has ever placed before him similar experiments made by accident or disease. I should be sorry to be obliged to venture an opinion as to whether the physiologist has more assisted the physician or the physician the physiologist in the elucidation of many obscure phenomena observed in the human subject.

Every one who is pursuing his professional avocations in a scientific spirit knows how large a part of the questions which he is obliged to discuss, and often unwillingly, are physiological. For example, a person is seized with paralysis of a certain kind, and we immediately ask ourselves where is the seat of the lesion. Now, if the physiologist had prepared the way we should long have left these questions behind us, and confined ourselves solely to the nature of the disease and its treatment; at present, however, we are assisting in his work. If the case be one of so ordinary a complaint as jaundice, our inquiry has not only reference to the disease, but to the causes which have made bile appear in the blood—a question only

to be decided by a knowledge of the functions of the liver. So in diabetes and many other diseases, the questions mainly discussed by the teacher before his class are purely physiological ones ; and this discussion bears its fruits. Witness, for example, the amount of knowledge obtained by ourselves relating to the functions of the nervous system ; such as the varieties of sensation, as of touch, pain, heat, and cold, together with the time of transmission of sensations, and many other phenomena associated with disease of the spinal cord, which could scarcely have been known had not the facts been observed in the human subject. Our actual acquaintance with the functions of the nervous system, as gained in the physiological laboratory is small compared with what may be learned in the wards of a hospital. Could we gain any approach to an insight into the remarkable properties of the nervous system, had we merely laboratory experiments to guide us, and had we never seen the vagaries of hysteria ? An acquaintance with simple physiological laws derived from observation in animals and healthy men, gives us no clue to some of the most remarkable phenomena we witness in women. It is from

the latter we get an insight into the complexity of nervous functions, and therefore to assume that the standard of these functions is to be made in the laboratory, and all beside considered abnormal, is to shut the light from our eyes. With the exception of the experiments of Waller and Bouchard, little had, until quite lately, been taught the student beyond the notion that afferent and efferent nerves were so many telegraphic wires proceeding to and from the centres ; but when he enters the wards of a hospital and witnesses cases of disease, and sees the muscles becoming atrophied, when one nerve is destroyed and the skin undergoing changes, when another nerve is irritated, he discovers that these cords have other functions ; he no longer regards them as mere conducting wires, but rather as active organs conveying a distinct nutritive influence over the body, and sees with the mind's eye a perpetual stream of energy coursing through the system, or alternately ebbing and flowing in hysteria and other similar nervous disorders.

Then, again, some of our members are engaged in the important department of mental alienation, a department necessitating the study of the mind

in its widest range. Here again the advantages of the physician over every other member of the community are immense. He has opportunities of observation which the pure mental philosopher can never possess. Looking at the brain as the material organ of the mind, and taking into consideration its intimate relation with the working of every part of the body, it seems impossible that the philosopher by sitting in his study and noting the faculties and powers of his own intelligence, can do more than propound doctrines of pure metaphysics; he cannot, except by a physiological study of other beings, and even animals, form a scheme of psychology or interpret a tithe of the actions of men and women in everyday life. This might be exemplified in innumerable ways. Thus the discoveries by physiologists and by practising physicians, Fellows of this College, while demonstrating the intimate relation between the convolutions of the brain and the muscular system, prove also the close alliance between psychic states and muscular movements. This may be illustrated in various ways, but perhaps we cannot do better than go to the stage for a confirmation of the doctrine. There we see not only the actor placing himself in

attitudes corresponding to the state of feeling he wishes to express ; but as some of the most famous comedians assure us, the very posture which they assume, suggestive of some passion of the mind, will cause the latter to grow into a reality until laughter may be excited or tears flow, which are absolutely genuine in their origin. Many a practical lesson may be learned from this physiological fact. A desponding man stooping forward in his chair may be made cheerful in spite of himself by a brisk walk with expanded chest.

With regard to the subject of language, too, I am bold enough to think that its study from cases of disease of the brain by our members has thrown more light upon its nature than the disquisitions of the pure mental philosopher. If, therefore, our College treats, as it necessarily must, the question of mental alienation, its members devoted to this branch of medicine may include in their sphere of inquiry the whole range of psychology.

If any further corroboration were required to prove the value of observing cases of disease in aid of physiology, let me remind you that such men as Darwin and Huxley have not hesitated to make use of our knowledge in order to further

unfold their doctrines. The late Croonian lectures also, given here by Dr. Stone, on the causes producing various pathological states, might be used also in explanation of physiological laws. I do not, therefore, regard Harvey, although his name is immortalised by a discovery purely physiological, as standing apart from the Fellows of his College except in his superior excellence. I would rather regard him as the king's physician assisting in the advancement of knowledge and unravelling the problems of nature. It is from this point of view that it is of more interest to me to regard our great master and teacher. His work thus comes home to us and binds us closer together in one fraternity. This view also tends to elevate us as a profession, and, to my thinking, places us in one of the most exalted positions that man can hold. If our vocation leads us to the study of our fellow-creatures, in both their bodily and mental capacity, what higher function can we discharge. Others in the State may frame laws which govern the people in their social and political relations, but beneath all these lies the individual man, with his instincts, his pleasures, and his pursuits, having their basis in his mate-

rial nature, a knowledge of which can be possessed by the physician and physiologist only, and upon which all social regulations must ultimately depend.

I hope I have not uttered a disparaging word against the study of pure physiology, for I would not for a moment deny the advantages or necessity of the pursuit. I have rather wished to express my opinion as to the duties of the physician in not overlooking his opportunities in promoting its advancement. I am quite aware that the mere contemplation of man, the paragon of animals, can never reveal to us the intricacies of his mechanism, or give us the interpretation of his mental faculties. The problems before us are far too complex and abstruse to be solved without first surmounting the various steps in the process. We must go back in animal life, and even to the lowest forms of vegetable life, before we can get a clue to the higher of nature's processes; we cannot even stop here, for it requires a knowledge of the ordinary laws of physics to understand many of the phenomena of the human body. Whether we look at the human frame, as a whole, or limit our attention to particular portions of it, these truths are mani-

fest. The very first fact which strikes us is that the body is made up of two halves, that is, that the body is double, implying necessarily that the nerve centres are double, and all the senses double. We may perceive in this fact a wonderful adaptation of means to ends, and how a knowledge of space in its three dimensions is gained, not only by our possession of two arms, but by our two eyes and by our two ears. We can see at once the advantage of this duality, but we hesitate to stop at a teleological cause when we find a similar dual arrangement even in senseless objects, and are forced to recognise another law of nature, that of form. Morphological doctrines require us to regard the whole of nature's arrangements, and therefore in this very question of duality many a person before, and since, the time of Abraham Cowley must have been struck with the very close resemblance between the human head and many fruits, especially the walnut. Cowley had a smattering of anatomy besides being a poet, and describes how the nut has a soft covering or integument, then a hard shell or bone, lining which is a thick membrane or *dura mater*, followed by a thin skin or *pia mater*, covering the convo-

luted seed itself, which is made up of two halves held together by a commissure. This very first fact in the formation of the human body, its dual character on which so many of its functions depend, and the use of which is apparently so obvious, cannot be discussed solely in reference to final causes, seeing we find its counterpart in the fruits of the trees, and even in the less developed leguminous pod formed by the folding of a leaf. Nature thus closely unites man with the grass of the field.

“ Nothing stands alone,
The chain holds on and where it ends unknown.”

But we do not stop with the organic world in our search after an explanation of some of the characteristics of our framework since mechanical laws cannot be unheeded. In looking at the packing of the brain in the skull, or of the intestines in the abdomen, can it be doubted that these laws are in operation, or that James Hinton was right when he maintained that in the production of the spiral, noticeable in the heart and other organs, we have an example of the more complex laws of least resistance. The more, indeed, we

study any subject in nature the less isolated do we find it, so that all our analogies appear but the expressions of human weakness, and we are forced to declare that all nature is one.

“From nature’s chain whatever link you strike,
Tenth or ten thousandth breaks the chain alike.”

We look at the earth’s crust and we perceive that it has been gradually formed, layer by layer, and, judging by the present rate of progress, that this has been in process for countless ages. We see remains of animals, now extinct, in the earlier formations, and others nearer the surface which had no existence in the lower depths. In the history of man himself we observe the same progression, and whether we take his propensities, passions, or mental faculties, we see the same law in operation. It may be language or any other of his attributes which we are studying, but it forms only one link in the great chain of phenomena, proving that our earth is going onward in the course of development. From any point of view we take, and upon whatever subject we fix our gaze, we come to the conclusion that the greatest discovery ever made by man about himself, and of

the earth, of which he forms a part, is the doctrine of evolution.

“The softest dimple in a baby’s smile
Ssprings from the whole of past eternity,
Tasked all the sum of things to bring it there.”*

To those who refuse to look intelligently around them everything is stationary, things are now as they ever were, and they choose to think that this view is necessary to a religious frame of mind; but the idea of development and progress is far grander and more sublime; it is felt by the thoughtful to be true and stamped upon our very nature. Coleridge the Christian, the philosopher, and poet, possessing one of the profoundest minds that England has ever seen, with a wide grasp of nature in all her forms, had a glimpse of what now is erected into a science of evolution and morphology. He says, “Every rank of creatures as it ascends in the scale of creation leaves death behind it or under it. The metal at its height of being seems a mute prophecy of the coming vegetation, into a mimic resemblance of which it crystallises. The blossom and flower, the acme of vegetable life, divides into corresponding organs

* Poems by Miss L. S. Bevington.

with reciprocal functions, and by instinctive motions and approximations seems impatient of that fixure by which it is differenced in kind from the flower-shaped Psyche that flutters with free wing above it. Thus, all lower natures find their highest good in semblances and seekings of that which is higher and better. All things strive to ascend and ascend in their striving, and shall man alone stop?" In this, which was written half a century ago, lies a vast and grand conception of the world and of man, its inhabitant, not only appealing to the scientific investigator, but to the moralist, the philosopher, and the Christian. It implies that the world is not made, but is being made, that all things are tending to the higher and better, that inferior and hateful things are left behind, and that for man himself there may yet be a continuous and higher development in another sphere.

Now, in seeking to gain a further insight into nature, we can pursue no better course than that which Harvey trod ; for after a careful perusal of his works, we are constrained to see, in every page, that he was guided by the true scientific instinct. His injunction to the members of the College was

to study and search out the secrets of nature by way of experiment. He clearly did not use the latter term in its more ordinary signification, but by way of experiment, he meant by way of facts, instead of by the way of fancy, for he says "It were disgraceful, with this most spacious and admirable realm of nature before us, and where the reward ever exceeds the promise, did we take the reports of others upon trust and go on coining crude problems out of these, and on them hanging knotty and captious and petty disputations. Nature herself is to be addressed." One might have thought that this maxim had been written with the pen of Bacon, but it does not appear that Harvey ever read Bacon's works, and, indeed, it seems nearly certain that his great discovery was made, although not published to the world, before the 'Novum Organum' was written. It is clear that Harvey learned nothing from Bacon, and this has led to the belief amongst some persons that he could not have adopted the Baconian method of inquiry, but that Harvey made his discovery by a simple deductive or *à priori* mode of reasoning, suggested by the presence of valves in the veins, already shewn by Fabricius. No one who has

read Harvey's works, and especially such a sentence as I have quoted as to the true method of research, could possibly have accepted this statement, for few better pieces of investigation are to be found in the whole annals of scientific discovery than his. He opened the pericardium, he observed the heart's movements, he cut into the organ and saw it squeeze the blood out, he then opened the arteries into which he believed the blood to pass, and witnessed the crimson stream ejected. He proposed to himself experiment after experiment until he had solved the problem of the circulation. No theoretic argument was his who had dissected every animal within his reach ; for reptiles, fishes, insects were alike familiar to him. His powers of observation are also seen by his not forgetting to make use of cases in the human subject, for in an example of aneurism of the subclavian artery, he noticed the different sizes of the corresponding pulses of the wrists. Besides, he himself knew what a deduction was as opposed to the method he had been pursuing, for he declared that if his discovery were true, then certain other truths might be deduced from it. He says " these truths, if proven, are not without their use in

exciting belief as it were *à posteriori*," and infers, for example, that if venous blood flows as he supposed from the circumference of the body to the centre, it would carry poison, like that of hydrophobia, the lues venerea, and the like, and "finally" says Harvey, "reflecting on every part of medicine, physiology, pathology, semeiotics, therapeutics, when I see how many questions can be answered, how many doubts resolved, how much obscurity illustrated by the truth we have declared, I see a field of vast extent before me," and we may add, a very fruitful field it has been.

How, then, can it be, that Harvey's discovery arose out of a mere consideration of the uses of valves when he himself applied the deductive method to his own doctrines derived from an altogether different process of inquiry. Harvey's was the true scientific method as adopted by Jenner and all other illustrious discoverers of our College, and indeed there is but one method. It may be a subject of great interest to philosophers and logicians to discuss the modes by which great results in natural philosophy are obtained, and therefore it is not surprising that the method

employed by Harvey should have undergone this strict investigation, seeing it was brought into use at the very epoch of Bacon. Bacon's work seems to have been to assist his fellow-creatures in throwing off the yoke which they had borne for so many centuries. His daring to put aside Plato and Aristotle, and to direct others to investigate and think for themselves constituted him a man of power; but whether he put them in the best way of discovery is another question which has long been discussed. Those who have chosen to call Bacon's inductive method equivalent to a collocation of facts, are pleased to quote Harvey's discovery as an illustration of what a very opposite method will effect, but their reasonings and their facts are altogether erroneous. In various parts of Bacon's writings there are a sufficient number of scientific allusions to prove that the author knew the difference between a theory and a mere collocation of facts; and as regards Harvey, his method was of the purest inductive kind. I cannot but think that those philosophers who have discussed the different methods of induction and deduction, and which of them leads to the most fruitful results, have themselves been deficient in true scientific instinct;

and, on the other hand, we know that our greatest scientific men, from Harvey downwards, had little technical acquaintance with the methods they were practising. I should say that most discoverers, indeed, were totally unacquainted with philosophic terms, or at least in their writings no allusion is made to the methods employed. Amongst our own friends engaged in researches, one seldom hears philosophy discussed; and indeed where such terms as inductive or deductive appear prominently in their pages, I have myself remarked that there is little hope of gleaning a scientific fact.

It is generally supposed that Newton never read Bacon's writings, but what a perfect model was he of the scientific man. What could be more splendid than for his great induction to bear such fruits as the discovery of the planet Neptune by a necessary deduction. Look at those amongst ourselves who are adding to our knowledge, and where we have an opportunity of watching their manner of working, we shall perceive that they are not consciously pursuing any method, but will declare that they have never read a line of Bacon, of Mill, or of any other philosophic writer. Whether

the enquiry be physiological, chemical or physical the method is one. So far from their being able to say whether the inductive or deductive process is the better, they are employing both. The scientific enquirer looks at some phenomenon in nature and asks himself its meaning. The fact to which his attention is directed is one which millions have passed by unobserved, or have regarded if known, as too trivial or commonplace to be worthy of notice; it is this exceptional acumen which probably constitutes his special power or genius. He takes the fact, forms a conjecture as to its meaning, and frames an hypothesis or, if you will, a guess. He then endeavours to find if this have a basis of truth, and he performs experiments calculated to test its value. He perhaps fails, and then forms another conjecture which he once more puts to the test. He may at last be confirmed in the view he has taken, he then widens his experiments and at the same time his conceptions grow larger, until step by step, theorising and experimenting, he is able to form one grand theory of the whole, which he again proves to be correct by the accuracy of the deductions which flow from it.

I think it is evident that the old methods which

Bacon denounced, of framing fanciful theories according to preconceived mental conceptions were all as he says, valueless ; at the same time a simple collection of facts, which some have declared was Bacon's reformed method, will also lead to nothing, for no new idea can flow from it. The true method of scientific enquiry is the combination of both systems, each alone being barren of results ; speculation and imagination alone are valueless, a simple collection of facts is meaningless, but the combination of the theorising and observing qualities must exist in the truly scientific man. No better example of this can be found than in the late Michael Faraday, who would work week after week in his laboratory with apparatus chemical or electrical, never making an assertion which could not be supported by facts, and who would yet at the same time be speculating on the subject in hand with all the spirit of a poet. There are plenty of persons who can sit in their studies and frame vain speculations, but to do this is not a rare talent ; there are others who can observe facts without possessing the power of analysis ; this too is of no great value, although the faculty of seeing clearly is far rarer and more

useful than that of having impressions and so-called views. The order of nature is to most of us a chaos, and therefore to decompose it, and analyse it, by a careful observation of phenomena, requires rare talents.

Jenner observed a fact, he sought an explanation, and put it to the proof. His was the correct and only method. The world goes on and sees an apple fall, or a frog's leg jump in a dish, or a heart beat, but no familiarity with these facts would excite the enquiry, why are these things so? Those exceptional men who see and ask, are the Newtons, the Galvanis, and the Harveys.

If then there be only one method by which truth can be discovered, we need no longer discuss how it happened (a fact which seems so remarkable to some persons), that this great discovery of Harvey should have been made before Bacon's treatise was published or extensively read: or further seek to refute the strange impression that Harvey should have worked in a spirit antagonistic to Bacon. I have shown how both these conjectures are erroneous, for Harvey worked as I have said in the one and only right way, being led by the true scientific spirit. Bacon, as may be seen in

many parts of his writings, was acquainted with the true method, although his protests against the speculations of the ancients, made him lay so much stress on what is called induction. Nevertheless, it may be considered remarkable that the results of Bacon and Harvey's investigations should have appeared at the same epoch, and that Harvey, master of the true method, had never read a line of Bacon. If these men had no knowledge of one another, we need not ask whence they gained their inspiration; but rather how it was that two men endowed with the same spirit of inquiry should have arisen on the earth at the same moment. I should answer by saying that a general development had been going on in the womb of time, and that the moment of fruition had arrived when the world looked upon Bacon and Harvey.

What makes the reign of Elizabeth shine out so brilliantly in England's history? If Bacon had strength enough of intellect to throw off the yoke of Aristotle and Plato, which for centuries had weighed on mankind, if Harvey soon afterwards had sufficient force of will to put aside his Aristotle and Galen, and search nature for himself, if

afterwards Newton discarding the then theory of the universe, set to work to find out for himself the principles of motion and forces, and if we see also in this Baconian time other men illustrious in literature, in statesmanship, in commerce, or adventure, we need no longer inquire which of these great men was the forerunner of the other, but ask ourselves what was the common spirit which actuated them all. The answer is that the whole country at the Elizabethan era was emancipating itself from an intellectual and spiritual thralldom. Aristotle and Plato had held despotic sway, and kept men's minds as it were in their iron grasp for centuries. Bacon had the courage and power to throw off the yoke, enough to constitute him a hero amongst the leaders of thought, and having felt his liberty, resolved thenceforth to be intellectually free.

It was a like spirit too which produced at the same period our Shakespeare, and men like Raleigh, Frobisher and Drake, who in a true and literal sense unchecked and uninfluenced by the geography of ages, fearlessly put to sea, and rested not until they had made an unknown world their own. The history of the time exhibits the

wonderful spirit which was actuating Englishmen, every man believed in himself and in his country, and this cannot be better exemplified than by the old and well-known story of the people rallying round their queen, on the news of the approach of the Spanish Armada. There was an awakening and moving spirit stirring the hearts and intellects of men. Each according to his power was doing his work ; whilst Milton was shortly afterwards to preach freedom, Harvey in his sphere of science was exploring nature, and Bacon, though not an investigator himself, imbued with the true spirit, was teaching men with his pen how they should seek truth for themselves. One did not learn from the other, a common motive impelled them all, and the same spirit which roused them to independence and activity was operating on those who at about this glorious period of our history, founded the two Colleges of Physicians and Surgeons.

It would be taking, however, but a very superficial survey of the history of science were we to look upon it as the work of the few great men whose discoveries stand out as land marks in the domain of knowledge, rather, we should say, that a host of lesser workers have contributed

their share in uniting these together, or even assisted in their production, for there is much truth in the saying of Goëthe—that discoveries are made by the age, and not by the individual. A moment's consideration shows that this must be so. It seems quite impossible for the human mind to look upon a complex piece of machinery such as we are surrounded by in the organic and inorganic world, and by any process of analysis unravel its various parts. By no such means can we arrive at knowledge, simple laws are first discovered, and these we make use of to explain the more complex phenomena, much of the material used in their solution having been prepared by comparatively unknown and obscure individuals. All our knowledge is strictly relative, and can have no other side but that perceived by the human mind. Nothing, I believe, is less true than the sentiment contained in the lines of the poet.

“Thy arts of building from the bee receive;
Learn of the mole to plough, the worm to weave;
Learn of the little nautilus to sail,
Spread the thin oar, and catch the driving gale.”

I believe that no contemplation of the bee or its hive would have taught us its habits or shown us

how it arrived at the mathematical precision of its cell. This can only be understood by a knowledge of facts and laws gained through centuries of work, and then perhaps they would not suffice for a true solution of the mechanism of the beehive. Man had for ages looked with awe on the lightning, but no amount of contemplation could have revealed its meaning; it could only be understood when the laws of electricity were applied to explain its phenomena, and these were learned step by step supported on so simple a basis as the effects of rubbing a piece of wax. The glories of the bow in the skies though gazed at for ages had never suggested the interpretation of the spectrum, but it was by the observation of a ray of light passing through a hole in a window of a small room that the meaning of the rainbow was revealed.

So in physiology we are apt to forget that it is by slow work, step by step, and often quite apart from the subject whose interpretation we seek, that we obtain fruitful knowledge. No contemplation of the human eye would have suggested the camera, but the building up of the camera by a series of inventions explained the mechanism of the eye. We have endeavoured to teach the

function of the tympanum and its chain of bones by the knowledge in our possession, but we now think that this was insufficient since the physicist has discovered the intimate relation between electrical and sonorous vibrations in his microphone. I think I am right in saying that no piece of mechanism was ever framed in imitation of a straw of wheat or the hollow thigh bone, but when by a series of experiments the engineer discovered that with the least material he could gain most strength, by making his support in the form of a hollow girder or tubular bridge, then we applied his discovery to interpret the meaning of the culm of grass or the human os femoris. No contemplation of the nerves ever excited man's imagination towards the fabrication of an electric telegraph, but, on the other hand, the insulated wire, the result of much labour and thought, was found to have its counterpart in the nerves, whose component parts it then explained. The action of salines and colloids on the human body was learned by means of parchments and tubes in the laboratory.

These facts should point out to us how fruitless it is to attempt to understand complex structures and phenomena, before we have arrived at the

necessary steps for their solution. This is eminently true of the nervous system, where we are endeavouring to understand its most intricate phenomena by the application of laws derived only from our present limited knowledge. The remarkable observations of late, with respect to anæsthesia in hysterical women, states of somnambulism and ecstasy, and very similar conditions found through all animal life, should make us feel that we have still to learn the meaning of nerve force. With our present imperfect knowledge, the attempt to understand it is like taking a child, ignorant of the very first laws in physics, before a steam engine and endeavouring to explain its action. We cannot solve a problem until we know the meaning of the terms in which it is framed. Thus we see our greatest men, like Faraday, endeavouring to master the simplest facts and phenomena, taking for their maxim "tota in minimis," all nature exists in the least. Harvey made use of all the known laws of his time, and hence the grandeur and fruitfulness of his discovery.

I might here remark that this gradual growth of knowledge is another example of the progression

which we witness in every department of nature, and might be used to afford further illustrations to philosophers who have contended so long over the question of innate and necessary truths on the one hand, or experience on the other, as the basis of all knowledge. They would see that our interpretations of natural phenomena have not been arrived at (as if often thought), by an investigation or analysis of complex conditions, but have been worked out, step by step, by the human mind by means of laws framed from the simplest observations and experiments, proving, as must ever be the case, that the subject and object are united. Thus, the mode of increase of our knowledge is by slow growth, and corresponds to the development which we witness in the material world. Just as the human body contains within it the whole of animal life, or ontogenesis is a counterpart of phylogenesis, so the human mind gradually unfolding itself and passing from simple to more complex laws, finds its counterpart in the creative force which has been bringing about the development of the world. The human mind has been creating afresh the laws which are found in operation throughout nature, and may in time,

like its corporeal possessor, hope to grasp the whole within itself.

Now, having satisfied our moral sense as to the duty of pursuing these objects, we may fairly ask as a scientific section of society, are we arrogating too much to ourselves in placing these discoveries so high, and regarding it as our chief ambition to be instrumental in augmenting their number? For we must know well that many persons whose line of life does not lie in our direction do not hesitate to declare that higher aims are to be found in philosophy and art than can possibly be met with in science. I, for one, however, would strictly maintain the right of scientific investigators to the very highest consideration, aiming, as they do, at some of the most glorious objects which man can place before him, and assert, moreover, that the view of our opponents is a puerile one. In taking natural science as our domain we include in it man himself, who not only inhabits the globe, but, as we say, forms a part of it, and it of him. We too frequently hear man spoken of as if he could have a separate existence from the world on which he lives, whereas he is a part of it, and has grown out of it.

It were, indeed, impossible to think of man or any other living creature as preserving his individuality apart from the world which he inhabits. I need not enlarge upon the trite examples of the uselessness of the eye without light or of the meaninglessness of the ear without the vibration of air, but ask you to consider the relation of the atmospheric air to the lungs. For if the bronchial tubes be regarded as analogous to the secreting tubes of other organs, and the contained air in them to the respective secretions, then there is really a portion of our body outside ourselves; the air around is not only a necessity of life, but it is as much a part of us as is the bile in the ducts of the liver.

An examination, therefore, of the material world implies a study of man who forms a part of it, and in studying man as we do other animals we include all his attributes, his appetites, his passions, his instincts, and his higher intellectual functions; and I myself can scarcely see what grander, what nobler pursuit can be followed. It might be thought that in a learned society like this I ought to apologise for attempting to vindicate the claims of science, and yet sometimes there are found those in our profession who, deficient in the true

scientific instinct, are influenced by mere literary cavillers in our newspapers and magazines. We believe these writers are altogether mistaken in their view of the lofty objects which are ever placed before us. They belong to a class who, no doubt, feel a great repugnance to all physical inquiry, they regard it as mean and low compared with their own soarings in the region of the imagination. I can quite understand how they shudder at the thought of penetrating beneath the surface of things. Just as I have myself felt on leaving the green fresh fields and descending into a dark mine in the bowels of the earth, so they instinctively feel a horror on raising the veil and beholding an object like the dissected dead body deprived of its outward form and beauty. These external attributes, they say, are enough for them, and to pry into the mechanism (in the words of a distinguished writer) is no business of ours; form and colour, besides a hundred other qualities, are the phenomena which are allied to the spiritual and excite the imagination; but the substance which underlies them is unpleasant to think upon, it is gross, it is material. All explanations of the working of the human body are styled mate-

rialistic, and this expression in certain circles has become a term of ill odour savouring of degradation, of impiety and even immorality. What shall we say to our great writer on art, the author of the "Stones of Venice," one for whom I personally feel the greatest regard, and whose works I peruse with admiration, when, in one of his last lectures at Oxford, after descanting in the most eloquent and rapturous terms on the beauty of the wings of the dove as it sails through the air, chooses to depart from his theme in order to pour his wrath on the anatomist who dares to explain its flight by a mechanism of joints, of bones, and of feathers. That this tone of thought is very prevalent we had an opportunity of perceiving at the time of the controversy on vivisection, the opposition to which was based virtually on the inutility of that particular piece of cruelty to animals practised by physiologists, since it led only to useless knowledge and fostered idle curiosity. I have just now quoted the words of one of the most eminent of the opponents of vivisection, that to pry into the insides of animals and discover the secrets of nature was no business of ours, and this, alas ! the expression of

a man renowned in literature two centuries after Harvey's exactly opposite incitation to discovery ! I should feel almost ashamed to speak of the literature which flooded the houses of society three years ago, did it not reflect the opinion of a large class of the public, and of those who are influencing many persons through their writings in the magazines. A contributor of one of these papers supported by good and educated people writes as follows : " Professor Huxley produces artificial blushing in a rabbit by cutting the sympathetic nerve. And what a discovery has he presented us with here. Maiden, that delicate tinge with which nature has taught you consciously, yet involuntarily to mantle your cheek with ever superadded loveliness, a loveliness which has hitherto been accounted too exquisite to be gazed on profanely is found to be after all but a vulgar thing capable of being produced mechanically ! But truly what sacred mystery of your being will not these magicians of science disclose next ? " The writer continues then in the most logical manner to declare that it was the culling this forbidden fruit of knowledge which brought the curse upon man.

I should have been ashamed to have quoted this

rhapsody, did not sentiments like these pervade the writings of those whose influence over society is great. They say, in a word, that all the world's a stage, and the men and women merely players, that God Almighty pulls the strings, and we are forbidden to look behind the scenes. They say you may admire, if you will, the shape and actions of the arm, and then expatiate on the mysterious power which enables an act of the will to move the limb, but you must not look at the mechanism to see how it is accomplished for that is material and degrading. Admire, if you will, the blush on the maiden's cheek, but forbear to disclose the secret springs through which the charm appears. Must we, again, go back two centuries to find the answer given by our great poet?

“This is an art which you say adds to nature,
Change it rather—the art itself is nature.”

It cannot therefore be a matter of indifference to us if we find that so many men engaged in literature and art feel a repugnance to science, and we may consequently ask ourselves, can it be true that all elevation of thought, imagination, poetry, and the love of the beautiful, are the peculiar attributes of one class only, and that the

man who dares to look into the composition and the mode of operation of the material world around him must pay so heavy a price for his passion for knowledge.

It were very sad if this were true, and might behove us even now to look around us and ask ourselves whether we are indeed well and worthily employed, but we refuse to believe so absurd a fiction. The wonder is how any one professing piety can regard the mechanism of God's works as low. We can understand the feeling which makes a man shudder at the sight of a dissected body, but when the strangeness of the sight is past, and he can contemplate it without disgust, it by no means lessens the appreciation of its beauty when clothed in its integument. Cannot he regard it with the artistic eye and yet have a more perfect knowledge of its anatomy. Hear what a learned professor of anatomy, Wendell Holmes, can say—"Science represents the thought of God discovered by man; by learning the natural laws he attaches effects to their first cause, the will of the Creator," or in the poetic language of Goëthe :

"Nature is the living garment of God."

Of course it is possible that a man, deeply engaged in a scientific analysis of a material object, may have his eyes shut to the sublimity and grandeur of form, or beauty in every shape, and be so dead to the more sacred feelings of our nature as even, as the poet says, to botanise upon his mother's grave, but this is owing to the man's idiosyncrasy ; his work does not harden his heart for we may quote sufficient examples to shew there is no antagonism between the man of science and the man of imagination. Have we no artists, no poets, no musicians in our own ranks ?

It may be true that the majority of persons are born Aristotelians or Platonists, but, nevertheless, it were not difficult to point to men most eminent in science who would not have disgraced any department of art. But fortunately we can find some of the greatest geniuses whom the world has produced, who have been able to seize upon all the attributes of nature in order to raise their imagination to the highest pitch. What an example of this was Goëthe ; he could study the meaning of the intermaxillary bone, of the vertebræ, dissect a flower, or analyse a ray of light, yet, withal, he could conceive nature in all its profundity and

beauty. Moreover, these studies in no way interfered with the genius which could create a Wilhelm Meister or a Faust. And further, should the scientific man not display to the world any faculties of mind dissociated from those employed in his more immediate pursuit, it were a scandal, it were false, it were ridiculous to suppose that his researches did not warm his heart to a full appreciation of the wonders of the subject which engages him. It has been my privilege to have heard since my student days lectures by several professors of zoology and comparative anatomy at the College of Surgeons up to the very present year, and I have observed with what tenderness, with what love they have spoken of the different animals whose structure and whose habits they have been describing. And it was the same with their great predecessor John Hunter; for, as Sir James Paget truly said in his oration, the expression of the great anatomist in the well-known portrait displays a smile akin to rapture:—"I cannot doubt," says Sir James, "that he attained that highest achievement and satisfaction of the intellect when it can rest in a loving contemplation of the truth; loving it not only because it is right, but because it is

beautiful. I cannot doubt that, in the contemplation of the order and mutual fitness in a great field of scientific truth, there may be, to some high intellects, a source of pure delight, such as are the sensuous beauties of nature to the cultivated artist mind, or virtue to the enlightened conscience. I believe that in contemplation such as this Hunter enjoyed a calm, pure happiness. So Reynolds, his friend, seems to tell of him. In that masterpiece of portraiture, which teaches like a chapter of biography, Hunter is not shown as the busy anatomist or experimenter pursuing objective facts. The chief records of his work are in the background; he is at rest and looking out, but as one who is looking far beyond and away from things visible into a world of truth and law, which can only be intellectually discerned. The clear vision of that world was his reward. It may be the reward of all who will live the scientific life with the same devotion and simplicity."

I believe there are men amongst us who so love nature that they might prove even to Mr. Ruskin that the microscopic cells and the spiral fibres seen in the dissection of the plant possess beauties of their own, and are but the elements which,

when grouped together form the shape of the branches of the trees, and determine the clustering of the foliage, which in this stage of development alone, he imagines can inspire him by their charm. One might even almost hope that the repugnance with which chemistry equally with anatomy inspires him, would disappear when shown the production of colours in the laboratory, and that combining henceforth this newly acquired knowledge with those sentiments which enable him so eloquently to describe the autumnal tints of the forest, he might be more at one with Shakespeare, that art is not added to nature, but that art itself is nature. What I should like to insist on is, that the material world can be examined in many ways, it may be regarded in an analytic and scientific spirit, or with the eye of the poet; but as every quality which the mind can conceive must be an attribute of nature, one view need not destroy the other; and more than this they are often but the two sides of the shield or even identical; for example, when the physiologist sees a boy walking along the road whistling, he says that as the forces produced in the boy's nerve centres are not being employed in intellectual

processes, they make their escape by whistling, just as a steam engine blows off the steam with a great noise when not doing useful work ; the poet wonders at the scientific man's materialism, and exclaims "the plough boy whistles as he goes for want of thought." One of the most remarkable examples, in my opinion, of a man who possesses both a scientific insight into objects around him, and at the same time the true artistic and poetic mind, is the professor of anatomy at Boston to whom I have already alluded. I should say that Wendell Holmes has the faculty more than any other author whom I know of analysing human sentiments, and showing their association with the material world around us. In some of his writings and poems it were difficult to say whether the physical, the chemical, the physiological or the purely spiritual idea dominate, and indeed must not all these and more be united in the mind of the creator of all things, or be phenomena, if you will, of the underlying substance. In a poem describing the death and burial of a child, all these attributes may be seen, the last verse running thus :

" At last the rootlets of the trees
Shall find the prison where she lies,

And bear the buried dust they seize
In leaves and blossoms to the skies ;
So may the soul that warmed it rise."

I have heard a preacher in his pulpit, after speaking somewhat disparagingly of science, declare that the child who plucks a flower and places it in her bosom knows more of the flower than the botanist who dissects it. It is no doubt true that the child may regard it with a reverence which seems incompatible with its destruction, but a knowledge of its structure in detail by no means diminishes the love for it as a whole. In exemplification of this I will again quote Wendell Holmes, who speaking of a character in one of his novels, whose sentiments assuredly betray the author himself, says, "He had kept in a singular degree all the sensibilities of childhood, its simplicity, its reverence. It seemed as if nothing, that all he met in his daily life, was uncommon or unclean to him, for there was no mordant in his nature for what was coarse or vile, and all else he could not help idealising into its own conception of itself, so to speak. He loved the leaf after its kind as well as the flower, and the root as well as the leaf, and did not exhaust his capacity of affection or admiration on the blossom or bud upon

which the poet lavished the wealth of his verse, Thus nature took him into her confidence. She loves the men of science well, and tells them all her family secrets—who is the father of this or that member of the group, who is brother, sister, cousin, and so on, through all the circle of relationship. And there are others to whom she tells her *dreams*, not what species or genus her lily belongs to, but what vague thought it has when it dresses in white, or what memory of its birthplace that is which we call its fragrance.”

I have felt reluctant and even almost ready to apologise for attempting to vindicate the high calling of men of science, and defend them against a widespread feeling as to the degrading pursuit of searching into the mysteries of the material world. I should not have ventured to do so did I not see our tables covered with magazines and high-class literature, as it is called, in which some of the greatest men in our country—men of European reputation, men whose names will be handed down to posterity as the pioneers of knowledge, men of the same stamp as our own immortal Harvey—are not only held up to contempt, but their teachings described as

degrading or even demoralising. Of course, these writers are blind ; they have not their eyes open to the wonders around them, or if they hold any opinion as to the meaning of the world it is associated with some philosophical or religious dogma which has formed its foundation. But scientific teaching must have its way ; for, as we believe, all parts of the world are held together by one force (and what is true of one portion is true of another), so scientific men must be pleased to see that the doctrine of evolution, first taught by them regarding material things, is seen to be a law pervading the world, and is now being made applicable to man in his mental and spiritual nature, both by moralists and divines. For if, as many hold, the imagination of man is but a reflection of the world around him, then evolution is as true as the older theories of a perfect world undergoing decay ; for the scientific man knows that life and death are but correlative terms. Scientific pursuits are ennobling and accompanied by pleasure of the purest and highest kind. Nature reveals her secrets only to those who wish to discover truth ; for while the dishonest man is repelled, and his only recompense is error, to the earnest investigator

nature becomes a moral teacher. Science conducts us through infinite paths ; it is a fruitful pursuit for the most poetic imagination. We take the world as we find it, and endeavour to unravel its mysteries ; but of the alpha and omega we know not. Enough for us to look at what is lying around us ; it is a part we see and not the whole, but we can say with the poet, "we doubt not, through the ages one increasing purpose runs."

I will detain you no longer ; what more can I say ? What grander image, what more glorious picture, can I set before you than that which we have come to contemplate to-day—the king's physician searching out the secrets of nature ?