A LECTURE,

INTRODUCTORY TO THE

SCIENCE OF COMPARATIVE ANATOMY;

SHOWING

THE GREAT IMPORTANCE OF ITS PERFECT CULTIVATION,

AND ALSO

ITS UTILITY TO THOSE STUDYING THE PHYSIOLOGY OF THE HUMAN FRAME.

Delivered at the Westminster School of Medicine.

By H. W. RUSH, M.R.C.S.

AND LECTURER ON COMPARATIVE ANATOMY AT THE WESTMINSTER SCHOOL OF MEDICINE.

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ADDRESS

TO THE

MEDICAL PROFESSION.

It will be seen by all who read the London Medical and Surgical Journal, published by a Mr. Renshaw of the Strand, that a Lecture, introductory to the Science of Comparative Anatomy, delivered at the Westminster School of Medicine, has been inserted by him in the last number (181, vol. vii,) without the name of the Lecturer being affixed. As this Lecture occupies a considerable space of the Journal, and is upon a science extensively cultivated, the omission of the Name of the Lecturer may seem somewhat strange.

As *the Deliverer of the Lecture* in question happens to be at the same time part Proprietor of the Journal, and its recognized Editor, he feels aggrieved at the underhanded mode in which Mr. Renshaw prevented his name appearing as the Author of the said Lecture.

A plain statement of facts, representing the trickery by which Mr. Renshaw accomplished his scheme of suppressing the Name of the Lecturer may not be inappropriate, or, indeed, without some advantage to Professional Men; *especially* that portion of them who may be unfortunate enough to have dealings with a Publishing Bookseller.

It may be in the recollection of the readers of the London Medical and Surgical Journal, that Mr. Renshaw has for some time been carrying on a warfare of opposition, with regard to what has been called *his* Journal: his opponent being Dr. Ryan, who publishes a Journal under a similar title, but which, to all appearance, is destined to outlive the pamphlet of the former. In consequence of like disputes connected with the dissolution of partnership between Dr. Ryan and Mr. Renshaw, having arisen between the latter and the Author of the Lecture, which is now submitted to the Medical Public in a separate form; he feels called upon to do this in justice towards himself.

The facts are these :—Mr. Rush, the author of the Lecture in question, consented to allow it to appear in the Journal, upon the condition that his name should be affixed to it as the author. This Mr. Rush considered he had a perfect right to demand, from the fact of his possessing a large portion of the copyright of the Journal : and, indeed, the affair went so far upon this understanding, that the name of Mr. Rush actually appeared affixed to the Lecture in the PROOF SHEET,—but was afterwards, (mark !) before the numbers were struck off, expunged by a *sly trick of Mr. Renshaw's*, who is supposed to have marched most valiantly under the cover of the night, to the Printer's, when he well knew that the author would not be present, to insist upon his right to retain his name to the Lecture, or of withdrawing it altogether from publication in the Journal,—placed his veto upon it, and, both illegally and treacherously ordered the Printer to omit it ; his motives for this procedure being simply, that a misunderstanding had occurred a few days prior to this *manly feat* on the side of Mr. Renshaw with regard to the conducting of the Journal, Mr. Renshaw demanding to *act as sole Editor*. Yes, reader, sole Editor ! although not possessing a particle of medical knowledge; and Mr. Rush, notwithstanding this presumption on his (Mr. Renshaw') part, insisting on having the Journal conducted by a medical man, according to the terms in the articles of agreement.

On the motives which stimulated Mr. Renshaw to condescend to this piece of double-dealing, Mr. Rush declines commenting, further than to submit, that a bookseller, being at the same time, from *his own confession*, too much engaged with his own trade, cannot be the best Editor in the world for a Medical Journal, which, before he meddled with it, had been conducted by a physician of some eminence. The medical profession, it is not doubted, will properly estimate Mr. Renshaw's interference, in thus surreptitiously withdrawing Mr. Rush's name from the heading of the Lecture. That injury was intended to the professional interests of Mr. Rush must appear plain, and Mr. Rush's motives in publishing this lecture separately are merely to neutralize that evil intention, and at the same time to caution medical men how they place their literary reputation at the mercy of an *Editorial Bookseller*. One word more. Mr. Rush's Lecture is not the first that has suffered from the mutilating propensities of this would-be Editor, to whom the Subscribers to the Medical and Surgical Journal are indebted for the deprivation of a portion of a course of Clinical Lectures by one of our most celebrated physicians, who, justly indignant at this supererogatory meddling, withdrew from the publication his able assistance and support.

H. W. RUSH,

1, Everett Street, Russell Square.

July 20, 1835.

Mr. Rush's reply to Professional Men, who have communicated with him upon the subject.

Since the before going remarks were sent to press, Mr. Rush has received a number of letters from his professional friends, requesting an explanation from him with regard to the omission of his name from the lecture in question ; some have asked him, if he was ashamed of his name being attached, others if the lecture had even been delivered, and again others, who, knowing in part the *Editional powers* of M. Renshaw, made a pretty shrewd guess, and asked *whether it* was not probable or at all possible, that Mr. Renshaw by omitting the name of the author, thought that he might have been considered *not only Editor,* and Bookseller, but also LECTURER.

Mr. Rush can only reply, to his numerous professional friends, by repeating the plain facts, which will be found in his public address, and then leave the profession to judge for themselves.

In conclusion, Mr. Rush begs publicly to acknowledge his grateful thanks, to all those professional men, who have taken upon themselves the trouble of enquiring into this trading like transaction so as to free him from those suppositions, which otherwise might have been injurious to his reputation and character.

July, 21*st*, 1835.

LOWE, Printer, Upper St. Martins Lane.

INTRODUCTORY LECTURE.

Gentlemen,—In presenting myself before you as Lecturer on Comparative Anatomy, it is not my intention to launch out into the fields of rhetoric, or to clothe the facts it will be necessary for me to explain, in a splendid mantle of high sounding words. No, gentlemen, mine is the humbler task of a teacher, not the arduous duty of the orator; my aim shall be, therefore, rather utility, than an ostentatious display of eloquence.

The science which I am about to inculcate, it is true, admits of the aid of glowing and impassioned language, and possesses within its ample domain beauties of no ordinary stamp: the symmetry and proportions of animated nature, together with their nicely balanced functions, the rise and fall, the origin and decay, of certain organs in various forms, and the proof that no particular organ is in itself essential to life. It will be my duty to show you, the curious disposition of the various parts, not of *one* animated body, but of the whole range of living things, whether they walk the earth, exist within its substance, inhabit the depths of ocean, or soar in the air. It will be my duty, I repeat, to explain to you their component parts, and to trace them from a state of incipient development in some animals, to their full expansion in others; to mark out the distinctive characteristics, as well of the meanest reptile that is scarcely seen crawling on the surface of our globe, as of the majestic and stupendous elephant, who shakes it with his tread; to lay open, in short, before your eyes, the mechanism of all created beings, and introduce you to a museum, in which whatever is endued with life, motion, and sense, constitutes the spectacle. Gentlemen, a science which claims so wide a kingdom, and embraces, I may say, if not innumerable, almost innumerable facts, you will confess cannot but demand much time in its development, and that lucid arrangement in the unfolding of it, which may tend to render its difficulties lighter, and to facilitate its acquisition. To accomplish the latter desirable end, I propose delivering, in the course of this season, sixteen lectures, which may be termed introductory to the science, since in them I shall not so much enter into its details, as endeavour to form a striking and comprehensive outline of the whole, so that a fair view having been given of its extent and bearing, the more minute and particular descriptions entered into during the

next session may be better comprehended and remembered. In reflecting on the subject, this has appeared to me to be the most eligible mode of proceeding, for when once a well-defined and intelligible picture of the aggregate has been exhibited to the mental vision, the separated parts are more easily referred to afterwards, and their peculiarities and distinctions better understood, and retained in the memory. Feeling thus, gentlemen, I must claim your indulgence should my efforts to render clear any portion of my subject appear to you to be unsuccessful, and I crave the boon with more confidence of its being granted, from knowing, first, that I have exerted myself to the utmost in order to avoid such a failure, and in the second place, permit me to add, from being convinced that the generosity which ever animates such an assemblage of worth and talent as that which I now have the honour to address, is prone to judge favourably, where the difficulties in the execution are great, and to condemn unwillingly.

Having said thus much, gentlemen, I now proceed to my subject, and in the first place must endeavour to trace some of the sources from which comparative anatomy or zootomy (which may be defined to be that science which teaches the difference of structure in man and the inferior animals) derived its origin. In attempting this, we are not left altogether to vague surmise, as occurs in exploring the origin of most other sciences, for in the sacred writings we are informed that the sons of our first parents offered up sacrifices of animals, long before animal food was permitted, and in doing this a division of the parts became necessary, since some were deemed impure and cast aside, while others were adopted as fit for the solemnity; proceeding on, we may conclude that when the world became more peopled, and wars ensued, the wounds inflicted by the coarse and barbarous weapons used, must frequently have exposed to view the internal structures of man in a greater degree than is the case in present times: the slaughter and division of the larger animals occurring at the same period, could not fail to strike the beholders with something like a comparison between their parts, and those of man. As civilisation advanced, and men became more secure in the enjoyment of their ease, new wants arose, and embalming, as practised by the Egyptians, might have added something to this kind of knowledge; not, however, much, since we find, from the writings of Herodotus, that the embalmers were obliged to draw out the internal parts piecemeal, in order to avoid mutilating the body. Enough nevertheless, must have been learnt in this way to demonstrate the analogy between the structure of man and the inferior animals.

The soothsayers and augurs, whose importance among the ancients was very great, could not have done much in the advancement of the science, for their examinations were confined to the great cavities of such animals as they slaughtered, and a simple inspection of the bowels made, from which they pretended to extract their prophecies. In some work attributed to Hippocrates, there is a tolerably exact parallel between the chylopoietic viscera of a man and a dog. In the third and fourth century before the birth of our Saviour, anatomy was certainly cultivated among the philosophers. Plato reasons on this science; and his cotemporary, Aristotle, undertook a natural history of the form and

structure of animals, at the command of his pupil, Alexander the Great, and seems to have illustrated his descriptions by drawings, an improvement of vast utility.

Zootomy is a term which is frequently given to comparative anatomy, and, in fact, it is the one which implies the demonstration of the science. It is so called from ζωον, "an animal," and τεμνειν, "to cut," while, on the contrary, the term comparative anatomy, which was given by Vicq-d'Azyr, is more intended to express the multitude of comparisons which we shall find existing in the structure of different animals, and was first so called from a comparison between the organs of inferior animals, and those of the human body.

The differences that exist between what are termed the general sciences and natural history, I shall not this evening consider to any extent, but briefly remark, that in the former, man has some controul over the conditions of the phenomena which he studies, but in the latter, the phenomena are not within his grasp; he can decompose and analyse them only by reflection and deep meditation.

On reflection, when we consider what a variety of conditions are necessary to animal life, we may at once almost conceive the everlasting task in endeavouring to detect the phenomena which support it.

The structure of all living bodies may be termed a porous texture, by which plates of a fibrous and solid nature, more or less flexible, intercept fluids more or less abundant, and this is called organisation. Now none but organised bodies are susceptible of life; every organised body has a form peculiar to itself, and is peculiarly adapted to its wants and habits.

The science of comparative anatomy I have said to be of very ancient origin, though until very lately it has not received its due cultivation. We observe from the oldest historical records we possess, that sacrifices of animals were offered to the deities by the priests of the Israelites, the Egyptians, and the Greeks. Moses, nearly six and thirty centuries ago, described the method of conducting these sacrifices among the Israelites, when calves, lambs, pigeons, doves, &c., were offered to the Deity as an atonement for the sins of his people. At this ancient period, however, we must not give them credit for more than ordinary observation, though Homer, in his poems, informs us that they possessed an intimate knowledge of the internal parts of many of the lower kind of animals. They possessed undoubtedly a knowledge of the position of the larger organs, they inspected the difference of appearance of the same organs in different animals; they were able, in a word, to distinguish a healthy organ from one that was in a great state of disease. Their object, however, was not for any rational pursuit; they merely wished to survey one or two of the larger organs, particularly the heart and liver, since from these organs their signs and omens of future events were taken. Indeed it is surprising that from the curiosity the internal parts of different animals must have then excited, that they did not cause more acute observation; but in those darkened ages, superstition and bigotry domineered over every science; the kings and priests, incited by artful knavery, did all in their power to check even the means of observation.

The first who appears to have examined the internal structure of the lower animals with a scientific view, is that eccentric but acute philosopher Democritus, a few hundred years before the birth of Christ. It is said, that when he retired into the unhealthy forests of Abdera, he selected a spot under a tree, where he was in the habit of sitting, surrounded by a number of animals for the purpose of dissection. Hippocrates, his contemporary, here visited him in his solitude, and acknowledges that he gained much information from the researches of this anatomical observer. This lover of medicine (Hippocrates), who afterwards gave much of his time to anatomical studies, describes the brain to have been a sort of cooling apparatus, to condense the fumes arising from other parts of the body; but in a letter which Hippocrates received from Democritus, the latter therein stated that the brain was the true seat of the operations of the mind. Pythagoras and Empedocles also directed their attention to the internal structure of animals. The Egyptian priests possessed also at a very remote period many opportunities of examining the viscera of different animals, as in that country some of them were worshipped as deities, and kept after death embalmed in the pyramids. We have frequently from these ancient monuments many of those animals brought to Europe in a state of high preservation. Geoffrey St. Hilaire brought, both from Upper and Lower Egypt, mummies of various kinds of animals. Herodotus and Diodorus Siculus have given some very interesting accounts both of the process of embalming and of the sacrifice of animals among the Egyptians.

Aristotle, who had every advantage afforded to him for the study of comparative anatomy a man could well possess, may be considered the first who made real progress in this science. His writings prove him to have been thoroughly acquainted with the animal machine, and to have been a man of very great research and deep observation. Few have been able to surpass some of his descriptions, and even Baron Cuvier asserts that many of them excel those given by Buffon.

From Pliny, whose works contain all the information of the age in which he wrote, and from the few facts of comparative anatomy his works contain, we may easily perceive the slow progress the science made during the long interval between these two philosophers. The science for many years, in fact, was dwindling away; and it was not until the sixteenth century that it was again cultivated. Columbus and Aldrovandus then pointed out the importance and practical use of this science, and opened a path for its future cultivation. The science has, since then, been gradually developing; but it was not until after the eloquent writings of Thembly, Rossel, and Ellis, that comparative anatomy was made a distinct branch of science; previous to this it had become mingled with some of the general sciences, but more particularly human anatomy. The countries that have most contributed to the progression of this science are Germany and France. Why we have been so slow in facilitating its progress is somewhat difficult to explain, for there is no country that possesses more opportunities than we do. We have, in almost every part of the world, territories of our own; there is scarcely any part of the world that

we dare not penetrate; but yet, from negligence, or for some no better cause, we have been the most scanty contributors. It is true that the labours of our countrymen have extended the boundaries of the science in, I may say, many of its departments. We are indebted to Hewson, Douglas, and more particularly to the immortal Hunter, for unfolding the darkened veil respecting the laws of animal organisation, and pointing out the utility of the principles of comparative anatomy with regard to disease in the human being.

It would be tedious, though perhaps not altogether uninteresting, if I were thus to continue and trace to the present day the men who have been keeping this science on the march; and otherwise, the short space of time allotted to me would not permit my giving you even a general idea of them. I will therefore briefly state to you that France and Germany have produced many more valuable works and specimens than any other countries.

I have already mentioned to you one reason that caused the difficulty in former times of pursuing this study, and I have named and given proof of its existence. For centuries, yea, even from the creation of things to the present day, there has always existed many foolish superstitious ideas with regard to the dissection of the human body. It was in consequence of this that zootomy was made a study, to throw some light, if possible, on the human frame; nevertheless, this *even* was not practicable at a still more remote period, as there existed also nearly as much superstition with regard to the dissection of some animals. These ideas, the offspring of darkness, are received now, by a more enlightened age, with that ridicule they deserve. The human mind is in a higher state of cultivation; the stalk upon which it has been engrafted is now become saturated with sap, which, though scanty at first, nevertheless existed in the branch previous to its being placed upon the half-sapless trunk; every science is consequently striding along, and undoubtedly each will be productive of good fruit. We cannot, indeed we must not, expect that each stock will be equally productive. We know that amongst so many we must find some worse than others. Some for their cultivation require a much longer time; others, in fact, manure them as you will, never arrive to any state of perfection.

It is not without astonishment that we look back, and find the progress that each individual science has made, and not equalling in utility the science under our present consideration; a study, in fact, which, putting aside the utility of the science, is one of the most natural, the most interesting, and the most beautiful of all the general sciences. A science, unequalled, then—a science that will hereafter be one of the most useful to the preservation and health of mankind—one which must always excite the curiosity of the philosopher—and one which, perhaps, after it has received its proper cultivation, will be the means of our detecting some phenomena explaining the intricacy of life. Has it not been hitherto the means of detecting the different actions going on in our own frame? It is true, that the lacteals were detected in the human frame; but before their discovery by Veslingius, did not Asellius for at least twelve years detect them in quadrupeds? Again, was it not zootomical knowledge that led Galvani to discover galvanic action? The thoracic duct was also discovered

by Eustachius in examining the viscera of a horse ; and had it not been for the dissection of animals, would the immortal Harvey ever have discovered the circulation of the blood ? These facts, gentlemen, will show you why an impulse was given to the study ; and, in a word, it will show that the science has relation with every other—indeed it contemplates the principles of nature's works.

In forming our ideas of life, it is necessary that we should observe its effects in those bodies in which the effects are most simple and manifest. " By thus considering it," says Cuvier, " we shall be convinced that life consists in a faculty possessed by certain corporal combinations."—" Life," he adds, " may be considered as a vortex more or less rapid, more or less complicated, the action of which is constant, and is always exerted on particles of the same description. And as all the individual component particles are thus in a state of continual mutation, constantly going and coming, we may assume that the form of such a body is more essentially and properly its own than the substance ;—the one is co-extensive with its existence, the other is gradually but incessantly changing."

As long as this motion continues, the body is called living ; when it has ceased, the body dies, the component parts undergo decomposition, and the body evaporates.

One of the most striking mysteries in the animal economy is the birth of organised beings. We find them, and, in fact, observe them, developed, but cannot detect how they are formed ; we trace them when attached to a body of their own kind, but which has been developed long before them ; in this state we acknowledge them to be germs. The point to which the germ is attached, and even the cause which gives it an independent existence, frequently varies ; but, without exception, it must always have a primary connexion. The two extreme limits, then, of existence, are *birth* and *death :* and if it were not that organised beings had the power of reproduction, there would be an end of existence altogether. From these facts we cannot help allowing that certain forms have been perpetuated since the origin of things, and that every animal is capable of continuing its own race. All the individuals belonging to any one of these forms constitute what is termed a *species.* Varieties, however, are mere ramifications of the species.

All living beings are, in a certain degree, metamorphosed in the course of their advancement to maturity ; certain parts are lost, and others more completely and fully formed during their advancement. We find enclosed within the skin of the caterpillar, the antennæ, the wings, and all the parts of the future butterfly. Contemporaneously with that skin disappear the jaws, the feet, and other organs which belong not to the butterfly. The feet of the frog lie concealed under the covering of the tadpole, and when the latter rises to become a frog, the tail, the mouth, and the gills are no more found. The infant, at its birth, loses the placenta and the fœtal coverings ; as it gets older, it loses almost entirely the thymus gland, and gradually is furnished with hair, teeth, and, at a still more advanced period, with a beard ; the body augments more in proportion than the head, the head more than the internal ear : while,

when the frame is fully developed, we find that the liver, the largest viscus in the infant, bears a much less proportion to the other viscera than in the infantile state.

In taking a brief sketch of the active forces of the animal machine, I may observe that the muscular fibre always exists where there is need for the operation of compression. The basis of this fibre is denominated by chemists *fibrin;* and it is this substance which nature has recourse to for carrying on the changes and transmutations necessary for vegetable life. The action of these fibres is, in part, controlled by the will, and hence called *voluntary*; there are some, however, over which the will has no power, and these are called *involuntary.* Thus the muscular fibres of the intestines carry on the peristaltic motion of the bowels, and the muscular fibres of the heart produce the incessant contractions and dilatations of that organ.

The transmutations of the alimentary canal, which are necessary to vegetative life, are carried on by means of irritation. For example, we find the food first stimulating the glands in the mouth, there causing a secretion of the saliva; it then enters the stomach moistened by the saliva, and there produces another irritation, where it causes an extra secretion of gastric juice. We now find, as it passes along into the duodenum, it becomes a still more compound body, and an additional secretion then takes place. A division now occurs; the most nutritious goes to the support of the fabric, through the medium of the lacteals, and renovates, or, as it were, re-excites both the nervous and circulating systems. The other portion, which is not proper for the support of the body, is carried along the intestines by means of the peristaltic motion of these organs, and is in fact the stimulus which causes the motion to take place. After the food has been taken into the stomach, these continual changes go on independently of the will; and if the animal is in a perfect state of health, is carried on without its being conscious of it. In some animals the excrement, instead of passing off by the lower outlet of the intestines, is again ejected by the mouth; but this takes place only in animals of the very lowest grade, and in them there is but one opening to the intestinal canal. There are some animals, however, in which we find the residue pass off solely by transpiration, and this class is much more numerous than the preceding, but in them also we have but one opening.

The circulating system, which is also intimately connected with the muscular, is carried on in some animals in a much more complex form than in others; some possess only a single or simple apparatus, others a double one; again, we find some that are furnished trebly. Some animals, however, exist without any whatever. The circulating system, though supplied through the medium of the stomach, is nevertheless, by its aid alone, incapable of continuing its action—it requires for this purpose another modification, viz., respiration. It is from a free communication of the surrounding element with the circulating system that the blood undergoes various changes, and appears indeed from this source to receive its vital renewal. All animals possessing a circulating system have a portion of their vessels destined to communicate the blood with certain organs, where it becomes spread out as it were over a large surface, so

as to render it more capable of a free communication with the surrounding element. We also find in all animals, whether their local habitation is land or water, a certain provision of motory organs to attract and repel the surrounding element, whether air or water, either into or upon the respiratory organs. Those animals which possess no circulation, if they are surrounded by air it becomes diffused through every portion of the body by a kind of elastic tube, and if water, it penetrates the system by means of vessels, or is absorbed by the skin. After the blood has been thus nutrified, it appears, as it travels along, to impart its nourishment to the solids, when it returns to undergo the same modification. As the fluids are thus undergoing continual changes, so we find the solids in their turn partake of the same phenomenon, and for each supply they receive, give off that which is no longer of use to them. Thus we observe that the blood incessantly renovates the composition of various parts of the body. We have, besides, the glands, which separate from the blood those liquids necessary to the animal economy, and others which secrete such fluids destined for rejection.

The muscular system appears subservient to the nervous, and its action is regulated according to the increased proportion of excitement received by the nervous system. Thus the mainspring of life in the animal creation appears to be the mutual influence of the muscular and nervous apparatus connected with the arteries and intestines.

From practical experience we have found that irritation existing in one part may be counteracted by exciting an irritation in another. Now, as the nervous system, the cause of irritation, is intimately connected through all its parts, we need not be astonished that sensations or irritations produce debility. If the stomach is over-loaded, and an uneasy sensation or greater irritation than natural is produced, many of the other organs become enfeebled. Again, if the mind from constant meditation is over-excited, it not only loses its power of recollection, but it is also injurious to the digestive apparatus, and the whole frame in consequence becomes weakened. Accident or disease may also produce in every part of the body sensations of greater or less acuteness. Every animal possesses to a greater or less extent the sensation of feeling, but in many animals some of the other senses are deficient. We find some without ears, without eyes, or without nostrils, and some are destitute of every faculty, with the exception of sensation.

Every movement of the animal body takes place through the medium of a sensation, whether voluntary or involuntary. Every extension of parts is occasioned by muscular contractions. The direction and number of muscles in each animal are regulated according to the motion the animal may have to execute, and they vary according to the powers necessary in every species. When strength is required the muscles have a bony attachment; the bones are articulated together so as to allow the muscles to play upon the bones as so many levers. In the vertebrated animals this strength is usually required, and therefore bones are necessary for their attachment. In the mollusca, the hardened parts are called *crusts* or *scales*, and in these not so much power is requisite. We do not find the muscles directly attached to the hardened parts,

but are connected through the medium of a kind of tendon. The bones, which are connected one with the other, are so united as to restrict their motions to certain directions, and to further facilitate this we have condensed fibrous cords attached to each of them.

It is from the connexion of these various parts, as well as from the different forms resulting from them, that animals are capable of exercising the different motions we find them so naturally perform. The muscular fibres of the heart, intestines, bladder, &c., as I have before stated, are not under the influence of the will. In these parts they are either circular, radiated, or straight, but have no bony attachment; even in the vertebrated tribe, strength is not here required. Their motions are, in fact, passive, and it is only either from paroxysms of rage, or from severe mental disease, that they become at all subservient to the will; volition then, as it were, bursting through its boundaries, extends its power over these forbidden regions—confusion, irritation, and disease are the consequences.

With regard to the nervous system, we find it somewhat analogous to the circulating, more or less developed in every organised being. Some animals exist without a heart, and others without a brain, and we observe some enjoying the pleasures of life without either one or the other. All animals, I have told you, possess a degree of sensation. Man, however, who is empowered with the greatest nervous mass, is the only animal that is capable of associating his general ideas with certain images, so as to call to his mind the circumstances they are intended to represent. These images or signs that I am speaking of, constitute what is termed a language; their expression by articulation is called speech; when brought before the eye, they are denominated hieroglyphics, or writing. By these signs we are enabled to collect an immense body of materials, and thus strengthen the power of our reason and imagination; they afford also a medium of communication, by which means the whole species are enabled to partake of the experience of each. Thus, knowledge may be raised in the course of time to an indefinite point of elevation, and extended to an indefinite distance. Some animals, however, though infinitely below mankind in their intellectual faculties, perform many extraordinary operations; in short, we observe in the superior animals something which simulates reason. We know that by experience they gain knowledge, and this knowledge appears regulated independently of the impulses of their ordinary sensations. In their civilised state they know that they are under the controul of man; they observe his superiority, and are fearful of his rage. They possess also a faculty very different from human intelligence, viz. instinct, a faculty which guides them to the preservation of their own species, though this faculty apparently is altogether foreign to their own desire. The workings of this faculty can neither be considered the efforts of imitation, nor can we consider it the principle of reason; we frequently find the particular actions produced by this power so extensive, so intricate, and so complicated, and in animals, too, naturally the most stupid. Every species possesses instinct of different kinds, and each, with reference to its own species, conducts its labours precisely in the same way: for example, if we take the working bees, we find

that they have, since the commencement of the world, constructed their splendid edifices in conformity with the strictest geometrical laws. The solitary bees and wasps also construct equally beautiful nests, in which they deposit their eggs; in a certain time a worm is formed, which in all probability never beholds its parent, and certainly in that state it would be impossible for it to construct a dwelling equal to that which contained it; but this worm, the moment it has become metamorphosed into a bee, will immediately construct an edifice, equally beautiful to that in which it was first deposited as a worm.

Having now taken a rapid glance at the various and necessary parts of the animal, I will next proceed and give you a brief sketch of the difference between it and the vegetable kingdom. I have said that animals are never destitute of sensation and motion, but we find that vegetables are deprived of both, and indeed reduced to the mere capacity of vegetation. Some plants, it is true, appear as if instinctively to withdraw from touch, yet this motion is too unlike that of animals to afford any proof of volition. One of the most striking characters which distinguish plants from animals is, that the roots of the former act as a digestive apparatus, while the digestive apparatus of animals act as the roots of the former. The organisation of the animal cavity must of necessity correspond with the nature of the aliment the species subsist upon; but we find that plants have always the juices prepared for absorption, and supplied from the soil and the surrounding element. The functions of the animal must therefore be of necessity much more complicated than those of plants. Another leading distinction between the animal and vegetable kingdom is the circulation; but I have already told you, that some of the more simple animals are also deficient in this respect. The muscular and nervous systems are also a third distinction. The chemical composition of the animal body also differs from the vegetable. The elements belonging to the vegetable kingdom, are oxygen, hydrogen, and carbon, while in the animal we have a fourth, viz. azote. The peculiar composition of plants requires that the hydrogen and carbon should be retained, and the superfluous oxygen exhaled: there is also in general a very small portion of azote absorbed, but for the support of animal life the inverse ratio takes place. The functions of respiration is also another very distinctive difference between animal and vegetable life. It would almost appear that these kingdoms live one upon the other, for we find the vegetable composition, of which hydrogen and carbon form the principal parts, one of the principal sources of nutrition for the animal; and again, we find the decomposition of the animal, one of the principal supporters of vegetable life. There are many interesting and striking facts that we may trace, when we come to consider the difference between herbivorous and carnivorous animals, connected with the vegetable kingdom. These, however, I will endeavour to point out to you, when we come to the consideration of this class of animals.

Having now, gentlemen, laid before you a portion of that general outline which I propose to finish in the course of this season, I must beg your further attention while I make a few observations on the great importance which ought

to be attached to the study of comparative anatomy; for, by its agency, what is often obscure and too faintly developed in man is rendered plain and conspicuous. By its light, as through a powerful optical machine, we are enabled to view what is microscopic in the human frame on enlarged and more obvious dimensions. To describe the amount of pleasure and delight arising in a well constituted mind from the pursuit of a knowledge so extended, diversified, and magnificent, so blended with the mighty operations and economy of nature, so beneficial in its results to mankind, would call for a force of language and splendour of diction, which requires an advocate gifted with more power of eloquence than the humble individual before you can lay claim to; but to the lover of scientific research, and the admirer of those harmonious laws, which, extending their sway alike over the meanest and the mightiest, point to an omnipotent and benevolent Creator, I would say,—here is a field where all you love and admire may be seen and enjoyed, and which is boundless as the gratification experienced in surveying it. In whatever light we examine this science, it still presents a most interesting aspect to the observer. To the mathematician, the symmetry and exact co-adaptation of the different parts of widely distinct races, the direction and dimension of the muscles, the moving powers acting upon solid bony levers, furnish ample matter for his speculation; he finds the best principle for constructing that triumph of architectural art, the dome, in the sublime model furnished by the human skull. He submits to admeasurement and calculation the cylindrical bones of various animal bodies, and finds in all a wonderful economy of substance and adaptation to their offices; nothing superfluous has been admitted, nor anything wasted. Durability, usefulness, and a saving of the plastic material, distinguish the works of our Almighty and benevolent mother, Nature; and it is not declaring too much, if we aver that, whatever mechanical contrivances the wit of man by painful research during the long lapse of ages may have invented, their prototype is to be found in one or other of living animated bodies, and requires but the eye of active investigation into her plans and operations to become manifest.

To the geologist, anatomising as it were the depths of the earth, and meeting in his inquiry the relics of long extinct creations buried within her capacious bosom, our science affords a light by which he may read their probable dates of actual existence, their forms while living, and the race to which they belonged; for, although but a few isolated remains of the perished being are submitted to the inspection of the comparative anatomist, its whole fabric may be delineated by him from these scanty materials as accurately as the flow of a curve can be described from its equation at any given point. The chemist and natural philosopher will also find in this science scope of indefinite extent for the prosecution of their peculiar inquiries, tending at the same time to their gratification, and the triumph arising from fresh discoveries, and to the lasting information and benefit of mankind. No niggard hand has spread the table at which they may feast; their onward course may be prosecuted without fear of being satiated, they will find new delights present themselves at every step, and new excitement arising to stimulate the appetite to farther exertion as fast

as the old ones fade; in a word, comparative anatomy is the consideration and analogy of forms simple in themselves, but so infinitely varied and combined that their range appears to be inexhaustible.

Lastly, gentlemen, after having briefly examined the different component parts of so extensive a subject, I must take leave to add a few words on its vastness and exceeding importance to the general interests of scientific knowledge, and the benefit of the social community. In its pursuit, whichever way our steps are directed, new objects are sure to present themselves, and furnish food for man's noblest faculty—*reason;* from its sources, boundless as the confines of our earth, the poet may gather images to enrich his song, and the philosopher deduce laws and inferences which, when afterwards carried into effect, may produce consequences as surprising as they are beneficial. There is scarcely any other science to which the one under consideration may not afford some degree of light. In the study of human anatomy and physiology, the illustrations it extends to the searcher after truth are indispensable; they stamp *certainty* on points which, without *such aid*, must have remained *conjectural.* To the transformations, also, which have from time to time taken place in our ever changing globe, comparative anatomy is a faithful guide; for the geologist, without the illumination it throws on his abstruse subject, would be a wanderer in darkness, or a pursuer of shadows whose true forms could not be scanned by any operation of his intellectual powers. The fossil remains of animals whose races have been long since extinct, and buried in the strata on which they in ages gone strode in a degree of might and stupendous magnitude of which their skeletons alone can now tell, are exhumed by the geologist to throw light upon his art; but in this he requires the assistance of the comparative anatomist. It is the latter alone can put together the disjecta membra of the broken up frame-work; it is he alone can restore the *lucidus ordo* to the scattered fabric. But his art is not confined solely to the contemplation of the bony structure of animals; he divests this rigid scaffolding of its soft envelope, and inquires into its form, relations, and offices; the connecting links, the ligaments, are scrutinised, and the various powers and functions of the muscles, the moving apparatus, estimated. Nothing in the animal economy escapes his observation, and finally, he *compares*, and by the lamp of analogy arrives at certainty, where before were doubt and imperfect speculation.

The fund of information, both instructive and agreeable, elicited by these labours of the zootomist, is extensive and highly encouraging to the student in his pursuit after similar knowlege. *Nor is there one of you* here present, and *resolved to persevere* in a science so rich in materials for pleasure and profitable attainments, who may not, by his individual exertions, furnish additional facts and discoveries to those already known. I may here observe, that one of the most surprising and pleasing departments of our science is that which considers the changes which, during the lapse of ages, life has undergone on the surface of the globe. The fossil remains of animals which existed antecedent to man upon the earth, are being continually discovered, both in the old and new worlds, and furnish proofs, strong as any documentary evidence, concerning the changes which have through successive centuries taken place in the numerous

races inhabiting our globe ; and facts of the same kind are continually increasing ; and this also is equally true of the vegetation which embellished the earth at that time, with which of course the animals were in close connexion. Now, new races of animals and vegetables have made their appearance, and superseded those whose ancient existence is only revealed to us by means of their fossil remains. Thus, in the course of ages which preceded the appearance of man upon earth, its surface has successively changed its aspect, its verdure, and its inhabitants ; the seas have nourished other beings, and the air has been peopled with other birds. I trust that although the field of comparative anatomy has of late been trodden with much energy and perseverance by some of our continental neighbours, of whose names I shall have frequent occasion to make honourable mention in the course of these lectures, that there are yet innumerable paths leading to useful discovery, in reservation for the exercise of our national talent, and that, although our countrymen have come late to the arena of emulative competition in this science, their onward course in its cultivation will, at no distant period, not only equal, but eclipse the fame of those who have gone before them. Gentlemen, the pursuit of this science is, perhaps, more captivating, after the first difficulties in its study are surmounted, than that of any other. Many of its subjects are easily obtained, and at an inconsiderable expense ; others may be observed in the different collections and museums now fast increasing in this metropolis. Of course the possession of the more rare specimens must, as in every other case, be the result of individual enterprize. But the magnitude and extent of this arena of scientific exploration, ought not to terrify or deter the young and aspiring traveller, who would venture within its bounds. It is true that even if gifted with the highest talent he may never reach its utmost limits, for, as I have already said, they appear to be infinitely distant ; yet enough may be learned by moderate exertion and assiduity, by the exertion of that powerful instrument in smoothing all difficulties—perseverance—to pave the way to a desirable and masterly knowledge of its secrets. Let no one, therefore, be disheartened at surveying the extent of this science and its collateral relations, for assuredly a desire to attain it, aided by application not closer than is usually bestowed upon the study of inferior arts, will accomplish the end in view. I say with perseverance, for the mental power, and that readiness of conception which, as it were, at once grasps, and intuitively, and rapidly reasons upon whatever subject is laid before it, appropriating it without almost an effort, is not alike vouchsafed to all ; and where it is wanting, it is consolatory and encouraging to know that there exists another impulse in the human mind, capable of producing results as great as ever the most splendid natural abilities gave birth to—that property, gentlemen, is perseverance.

By *it* the most stupendous results have been effected—by *it* the slow in apprehension, but laborious in investigation, may, as with a master-key, open the door to every science. But while impressing on your minds the beauties of the science which now engages our attention, and inculcating the advantages which its pursuit will confer, I must not forget that it is my province to do so with the modesty and humility which becomes a teacher commencing his

arduous career. That such feelings are mine, I beg to assure all now before me, and, further, to add, that it is my fervent desire, in the execution of the task I have undertaken, to prove myself worthy of your confidence, and to discharge my duties conscientiously, yet zealously. In doing so I feel convinced that both my own and the interests of such as may be pleased to rely on me, and become my pupils, will be best consulted and secured.

It remains now for me, gentlemen, to state briefly the plan which I propose to follow in the fifteen succeeding lectures I shall have the honour to deliver during the season, in this theatre. It is my intention then, to invert, in my general outlines, the routine ordinarily adopted in teaching the minutiæ of the science; that is, instead of beginning with the lowest order of animal life, and ending with the highest and most complex, to describe the latter first, and so proceed downwards, until we reach that dimly defined and almost imperceptible boundary which separates animal from vegetable life. In pursuing this course, I venture to assert that its parallel may be found in another science as widely useful and extensive as our own—I allude to the calculation of numbers. In these operations, in the one instance, we begin from the unit, and descend in the scale to the smallest infinitesimal, as in decimals; while in the other, as in whole numbers, we commence at the bottom of the standard, and rising, proceed to its utmost limits. Whichever scale we follow it may be effective in itself, and by reversing their relative positions, *perhaps* a better understanding of both may be attained. Thus far, then, I mean to innovate on the usual routine of teaching our science. In my succeeding introductory lectures, I shall proceed from man, the head of the visible creation, downwards to the verge of mere organic life; but in the more difficult effort of pourtraying the minute parts of this science, which shall be the business of the next session, an opposite line will be drawn, and commencing with the inferior forms of creation, your attention shall be gradually directed to its supreme limit. Finally, gentlemen, I have to thank you for your attention this evening, and to entreat, if anything has been neglected or omitted in this my opening lecture, the omission may meet with that indulgence and favour which erring human nature is too often in need of, and which I am willing to believe you will kindly concede.

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