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Address on Evolution.

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On Saturday evening Dr Struthers delivered an address on "Evolution," at the request of the Medical Students' Society. Students of the other Faculties were also present by invitation of the Society, and members of the medical profession and of various societies were among the audience. The attendance was large, the new anatomical theatre being completely filled. Mr John McCulloch, President of the Society, occupied the chair and introduced the lecturer.

Dr Struthers began by remarking that when he was asked a few days ago to give an address before this Society on the subject of Evolution, he felt in some difficulty. The subject is still a somewhat delicate one, it is not easy to handle an intricate subject satisfactorily in one evening, and the request had come upon him in the midst of a very busy time. But when such a request was made to him in the name of young inquiring minds, he was not the man to refuse. He understood that, while the members of this Society were desirous of hearing the anatomical facts with which they are already acquainted viewed in relation to the hypothesis, they desired that the subject should be handled so as to be made intelligible to the general students whom the Society had invited to be present. Those who have read on the subject are aware that it has a very wide application, to the whole known universe, beginning with the solar system, coming to the crust of the earth, and to all living things upon it, plants and animals. There are not wanting those who seem to think themselves qualified to pronounce judgment, especially of the denunciatory sort, over the whole field, without having first practically studied any part of it. That example they would not expect him to follow. He might have his impressions, derived from reading the works of man

who are authorities in their several departments, but as no one's opinion can be of value who does not act on the principle of the shoemaker sticking to his last, he meant to confine himself to vertebrated animals, including man, and it so happens that this takes in the chief point of interest in the battlefield, the relation of the higher animals to man.

The general resemblance of parts between man and the higher animals has always been recognised, and is evident to the superficial observer. Even when the more exact demonstration of modern times was given of this resemblance, the question as to its meaning was scarcely raised. Such phrases as unity of organisation, unity amid variety, were deemed sufficient. When it became clear that the idea of special design, the argument from final causes as it has been called, was untenable, the idea of a type, or archetype as it was called, was set up. The argument was shifted; the design it was said might not always be seen in the special structures, but it lay in the type, and so the argument was saved. One detects here the rather dangerous practice of using old words in a new sense. Rather than confess error, the old shibboleth is used in a totally different sense. The pea was shifted under another thimble, and we had another fine example of what, he hoped without injustice, may be called verbal or theological thinkbripping. Was this not an instance of the practice which was condemned more than eighteen hundred years ago, that of putting new wine into old bottles? It was a curious part of this new argument, that the type was suggested to be for our benefit, that is, to put it in unphilosophical language, certain structures exist in, for instance, horses and whales, not for any special use or meaning in connection with horses or whales, but for the purpose of instructing mankind, or at least that part of mankind which is so fortunate as to study anatomy. Does not this read something like saying that the rivers were made in order that mill-wheels may be driven and that artists may have scenery for their pictures. Teleology, using the word not in its physiological, but in its metaphysical sense, the sense in which it is now generally accepted, is very slippery ground, so slippery that one treads it with more and more caution the older he grows, remembering the many tumbles he has had and witnessed. The teleologist is apt to find

himself following in the footsteps of the professed philosopher who remarked that it is a wise arrangement that the great rivers had been made to run near the great towns. Nothing is to be gained by entering on discussions about design, and one grows heartily sick of all these attempts to praise and shape modern science so that it shall square with the philosophy of old writers. If you are driven to it, begin by insisting on a clear definition of terms, and a distinct acknowledgment that the old argument is untenable and that a new argument has been set up. After that you may go any length with the word design, as a mode of expressing the harmonies and adaptations with which the universe abounds, recollecting always that you are discussing a metaphysical question. The objection to bringing metaphysical speculation into the domain of physical science was long ago clearly pointed out by Bacon, the practice, as remarked in the "Advancement of Learning," leading "to the great error and prejudice of further discovery." So it did here, for this theory of an archetype dominated scientific anatomy in this country for nearly a quarter of a century. Let us avoid all such unprofitable discussion, and go directly to the primary question—Whether, according to the older notion, species of animals came into existence independently of each other, or whether by descent from previous forms. Here it may be as well to remark that the question at issue is not one of creation or no creation, but of the mode of creation. We are told now that although evolution may be true, or probable, it must be caused evolution, not self-evolution. On this it must be remarked that it is not evident what the phrase self-evolution can mean. We know what gravitation is, or at least what is meant by it, but what would self-gravitation mean? Nor can we conceive of evolution without a cause any more than of gravitation without a cause. Observe that the older hypothesis amounts simply to a statement that animals were made. It offers no explanation of the process. The evolution hypothesis, on the other hand, offers a theory or method for the process. It suggests that animals began, as they begin now, by being young ones first, that what are called species have in some way descended, with modification, from previous forms. In the absence of all positive knowledge on the subject, it suggests that the facts are more reasonably accounted for by evolution than by

supposing each species to have been begun independently. Here the general theory of evolution may be said to stop, but the further theory of Mr Darwin offers an explanation of how this evolutionary process may have worked. Recognising the fact that variations occur naturally, he suggests that natural selection, the survival of the fittest in the struggle for life, has been the method, over long periods of time, by which the species now existing have been evolved. It is impossible to overrate Mr Darwin's merit in connection with the evolution theory, for in giving wheels to it he may be said to have made it his own; nor, it may be added, would it be easy to overrate the value of the stimulus and direction which his writings have given to workers in anatomy, zoology, and botany; but it is not so much with his theory, as with the evidence of the general theory of evolution, by whatever means or method, that we are primarily concerned to-night. Of the evidences which admit of being brought to bear on the two rival hypotheses, anatomy is the chief source, the anatomy of the embryo and the anatomy of the specialised adult. Observe the position in which the older hypothesis places this evidence. To account for the resemblance it is necessary to suppose that, in the making of each new animal, the structure of other animals was copied, although the copy might not be specially for its benefit; and that this copying process, with its variations which are acknowledged to exist, goes so far as to place structures in an animal for which it has no use. This is a plain way of describing what is usually called type or common plan, and however unsatisfactory it may appear, we are shut up to it as long as we cling to the idea that each kind of animal had an independent origin. The evolution theory, on the contrary, looks with a natural eye on the fact of resemblance. It suggests that this resemblance is simply the result of inheritance, just as the structure of the young resembles that of the parent; and in exchange for the pleasing metaphysical fancy of a type, it offers to us the solution of the great problem. Unfortunately, this question has to be tried before a far from unprejudiced jury, for we have all imbibed in early life the impression that species of animals were originally distinct, and therefore we go into this discussion heavily weighted on that side. We are too apt to treat it by at least the first

part of what is known in the south of Scotland as *Jedburgh justice*, which is hanging a man and trying him afterwards. Let us endeavour meantime to suspend our prepossession, the condition indeed, on which all our beliefs should be held if it is truth that we value most. It is also unfortunate that the evidence here is of a kind requiring a knowledge of anatomy, or a good deal of anatomical demonstration, for its due comprehension, so that the general reader, in the absence of this, is apt not to perceive its full weight.

Dr Stirling then proceeded with the anatomical demonstrations, which formed the chief part of the address. These were selected from the various animals in the vertebrate class, fishes, reptiles, birds, and mammals, including a considerable number from the human body. The demonstrations related chiefly to rudimentary structures, which he discussed in their early and in their adult condition, illustrating his remarks by dissections and drawings. The question which they would put to themselves in connection with each demonstration was—Which of the two hypotheses affords the best explanation of these facts? Rudimentary structures, he remarked, present various degrees of rudimentaryness. Some must be relegated to the position of the entirely functionless. In what other way are we to account for the ossified teeth which come and go before its birth in the whalebone whale, or for the deep sunk concealed teeth of the bottlenose whale, or for the occurrence of soft germs of upper front teeth in the calf which never ossify, except by the supposition that these animals are descended from animals which possessed functional teeth in these situations. Many structures are rudimentary, but of which it can hardly be said that they are entirely functionless. On the contrary, a certain low amount of function rather explains their persistence. But it does not explain their occurrence, or the circuitous mode, so to speak, in which they have been developed. Two horses of tolerably equal size drawing together in a plough we can understand, but if we see one of the animals much reduced, say to the size of a mouse, with all its harness, we could not exactly say that it was quite useless, but might venture to suggest that a little more care in the larger animal would have done as well. The illustration comes to one when we see the

plantaris muscle of a man, or of an anthropoid, pulling alongside of the great muscle of the calf of the leg, and when we compare its relaxed condition with the robust development of the corresponding muscle, for instance, in the dog. Again, if the horses of the present day were made originally as horses, it would not be easy to understand the mode of development of the forearms, or of the splint bones, but the whole facts are at once and fully explained on the theory of descent. That refers to normal rudimentary structures; but when we come to variation, the older hypothesis falls still more. According to it, it is not easy to see why there is any variation at all, why, if each species was made independently, its descendants should not be as like one another as the copies of a book from the same types. If the teleologist were securely logical, he would be driven to say that variations were overbores. If it is held that a variation occurring, say in one of every hundred individuals, is for us, we fall into the pit of virtually saying that the other ninety-nine are imperfectly made. How can the theory of the original independence of species account for, or be reconciled with, the occasional occurrence of the supracondylar process, a most beautifully constructed arch? The last illustrations selected related to the early development of the embryo, the evidence, the lecturer contended, which forced itself on us being, that the first individual of each so-called species had been not an adult, but an embryo. In concluding his illustrations, Dr Strickland remarked that the general conclusion forced on us by a survey of such facts, notwithstanding the prepossessions of our early education and our lingering affection for them, is that the old notion that species arose independently of each other must be a mistake, that the probabilities gather more and more in the direction of origin by derivation, whatever the cause or whatever the method. It is true that this is as yet only a hypothesis, but it is the more probable of the only two hypotheses, and what have we, for the most part, for our guidance in life but hypotheses? Call it what we like, the evidence is in its favour in of such a nature as to produce the impression that whatever is not in accordance with it will ere long have to set its house in order. It is to be lamented that a view which suggests so much loftier conceptions should have been received with so much disfavour, but considering the short

time that has elapsed there is not much ground to complain of the progress it has made among the scientific workers even in this country, and it is surely the duty of those whose position renders them the keepers of the evidence to do their part in bringing that evidence forward.

In the concluding observations, Dr Struthers said, which I have to offer, there is, in reference to some of the thoughts which may have been passing through your minds on certain bearings of the theory, one point to which I am desirous of alluding. It is probably the last opportunity that I shall have of formally addressing some who have nearly concluded their education here, and I should not like to be misunderstood. I have to ask you to bear in mind the distinction between religion and theology. With religion no form of truth can ever clash. Religion is a thing of the heart and the conduct. It is tolerant and marked by that charity which thinketh no evil. It is a thing not between man and man, but between man and the Almighty. In contrast with it, one great characteristic of theology is its intolerance. While science and religion must ever go hand in hand, science and theology have long ago mutually declared war. Besides the more or less constant skirmishing, they have fought some memorable battles. The first great fight was with the astronomers. You all know the story of Galileo. Well, it ended in its being admitted that it is the earth and not the sun which turns round; theology was worsted, but religion was purified. Then came the fight with the geologists, the last gasp of which, discharged by the retreating force, some of you may be old enough to recollect. The cry was that religion was being undermined. Well-meaning people joined in the cry, but most of the harm that is done in the world is by well-meaning people. It was only theology that was in danger. Religion was again purified, and theology so far went to the wall. The history of these struggles is strewn with the wreck of old dogmas. In the present struggle, that with biology, anatomy, in its morphological, embryological, and histological departments, plays the chief part, as holding the internal and deeper evidences. The battle is well advanced, so far advanced that offers of submission are coming in in the usual form of reconciliations. It is now being discovered that the evolution theory may be viewed as almost if not quite orthodox, and it is a

hopeful and cheering sign to see more than one book, and good books they are of their kind, making their appearance lately in this direction. Our dark enemies the Infidels, in making their sublimation, also beaten by the force of superior sciences, have to accompany it with a handsome payment in cash; but for their indemnity the soldiers of science need not look for more than a gradually dimming fire of retreating shots, with hard muzzles for the bullets. Education is doubtless making rapid progress in the community, but it is a lesson which each person has to learn for himself. By toleration we now-a-days mean, first, that a man ought not to suffer in his person, that he is not to be imprisoned, tortured, banished, burned or beheaded, on account of his religious profession. This the law now interferes to prevent. Further, we mean that neither is a man on that account to suffer civil disability, that is, in his person or in his position; and this also is now pretty well secured in the statute book, as far as the statute book can secure it. But by toleration we mean more than these: we mean the spirit as well as the letter, that it shall be exhibited in our conduct and our conversation, and that it shall pervade our very thoughts and feelings towards those who differ from us. We are to believe not only that they are sincere, but that they may be right, although we think it is we who are right. Since the time when this grand conception dawned upon the immortal Milton, our great apostle of the freedom of the human mind, we have reached it practically by sad experience. Toleration of differences of opinion in matters of religion, and not in them only, is the greatest practical idea which civilization and education can bestow on us, and I have no hesitation in saying that a University falls short of its high vocation if it does not send out, from all its Faculties, its young men imbued with this noble lesson, a lesson which is at once the property of philosophy and of christianity.

How is it that questions such as that with which we have been occupied to-night encounter so many prejudices in this country, compared, for instance, with Germany? In that great country, the land of Luther, and in the future to be still greater country, we have long been surpassed in philosophy, in theology, in science, in learning of every kind. We have lately seen with admiration,

in one of the most memorable wars of history, that education can make not only a nation of philosophers but also a nation of soldiers, and, it is now drawing on our national conceit that the German *YF* about to surpass us even in our stronghold of manufacture and commercial enterprise. The explanation does not seem to lie at all in difference of race, and it is easy to see that it lies in the deliberateness of our educational institutions and of our educational methods, in our Universities and schools alike. Increased education implies increased expense, but is it not an unwise economy to starve the education of a nation? There is an old saying, that a pound in the hand is worth five in the pocket. We have at present a surplus of several millions, about the spending of which speculation is rife. It seems to have occurred to no one to put in a word for education. We ought to have the natural sciences more widely taught to the people. They ought to be taught to some extent in every school, and in every town, or centre of a district, there ought to be a museum of natural objects, not large but well classified, and the means provided for teaching the experimental sciences experimentally, so that all the children might be taught to use their eyes on the phenomena of nature, and their minds in reasoning from them. There ought also to be schools for technical education, that is, the training of young men, head and hands, in the science and art of the occupations which they are to follow. What our Mechanics' Institutions, and the so-called Department of Science and Art, are doing on a limited scale with their poor equipments and wretched rooms, ought to be done on a large and liberal scale. But if the natural sciences are to be taught in schools, who are to be the teachers? The teacher cannot teach what he does not know, and if he tries it by mere lesson-learning from a book, it may be worse than useless. Is it not the function of the University, the highest and noblest of all teaching functions, to be the teacher of the teachers? What the Universities do for what is called general education, and for the professions is well, if the method were better, but they ought now to think of the teaching profession, arrange a curriculum for the teacher, and stamp it with a teacher's degree. I say of the work of the Universities, that it is well if the method were better. I ask you from your own experience whether our Universities are free from the fault which, I assume

to me, pervades all our education, from elementary schools upwards, the fault of mistaking lesson-learning for education, mere learning by rote, mere committing to memory, mere parrot-work, to the neglect of training the observing and reflecting powers. Is it not the case that those who talk so loudly and so justly against cramming, are themselves engaged in practicing it? I apply this remark to all our education, but with a special meaning to our own department, I mean the natural sciences. We hear it said by some that natural science is but a poor educational instrument, that it may be got up by cramming in a few months, while you may spend ever so many years on the dead languages, and not have got to the bottom of them after all. When I hear that, it is to me a sure sign that the natural science of the speaker's experience is no natural science at all, but what I would rather call unnatural science. It can have been only a sham and a pretence of science. I rather think that the word natural science is used in some quarters in a very limited sense, and the whole cry about it seems to have its beginning and its end in the miserable affair of attendance on somebody's lectures. Natural science is at least half-a-dozen sciences. On the physical side we have Physics, called Natural Philosophy in this country, but somehow not commonly supposed to be a natural science; we have Chemistry, and we have Geology; and on the biological side we have Botany, Zoology, Anatomy, and Physiology. Now I say that neither of these sciences can be taught merely by lectures, I mean even by lectures of the right sort, and still less by those venerable lectures of the routine kind, the proverbial "candle ball." They must be taught experimentally and demonstratively, not merely in the lecture room, but practically to individuals, each teacher devoted to his department, and working with his pupils in his laboratory. I say laboratory, meaning working rooms of all kinds, or whatever nature is to be studied, in contradistinction to lecture rooms or talking rooms. I say it without fear in this Society in the presence of many of my former students, and I think I am entitled to say it as one who has spent a large part of his life in practicing as well as in advocating such teaching, as one who, in order to do so has given up, for many years of his life, his day to it when less than half the day would have sufficed for the common method.—I say that the talking and cramming method is a miserable

waste of the student's opportunity. Take the great science of Geology, a science of profound interest, one to which, I am sorry to say, the student of medicine has not had his attention much called. Do not suppose for a moment that I propose to add it to his examinations, for one straw more would be apt to break that camel's back. But it is a subject which every one, as a human being, ought to study if he wishes to understand the history of life. Well, will you ever learn Geology from merely hearing a course of lectures, illustrated perhaps by some panoramic pictures? Much may be done in a museum by stone and plastic models, carved and coloured, but you must be taken out to the great laboratory, to the hill-sides, and river-sides, and sea-shore, to the quarries and the railway cuttings, if your knowledge is to be real. For Palæontology you cannot have everywhere such collections of the objects as you have in London, or Paris, or Munich, but, besides such natural objects as can be had, classified and labelled, I would have the museum-room hung round with classified and labelled illustrations, such as those issued by the Palæontographical Society, so that the student, or the schoolboy, or the working man, might see from day to day, as he walked round the museum, the kind of animals which have lived and passed away, the study of which forms one of the pillars on which the evolution theory rests. While I apply this criticism specially to the still too customary method of teaching the natural sciences, I apply it generally to our university work. Our universities should be less great grinding shops, and be more great training schools and great debating societies. You wish to learn music, and you expect to be superintended in your practice and have high examples put before you. You know that it is not given to every man to be a composer, a Beethoven or a Mozart, but you expect that the man who teaches music will be able to sit down to his instrument and play before you the best music of these great masters. You join his class, and you find that from day to day he only sits before you turning the handle of the barrel-organ. Our universities must aim at more genuine work. Using the language of evolutionary metaphor, we must have less inheritance and more variation; more of the struggle for life and its results, progress by natural adaptation, and the survivorship of the fittest. According as the one or the other

system is pursued, the student may, on the one hand, be sent out into life as the mere recipient of dogmatic opinions, to spend his life in defending them, in worship of the past, and in vain opposition to the progress of science and of thought which everywhere surrounds him. Or, on the other hand, he may be sent forth trained to observe for himself and to think for himself, educated and prepared to continue through life that education which must ever be going on if we are not to fall behind the age in which we live, appreciating progress and contributing his share to it, and thus exercising and enjoying the high privileges of the human mind.

At the close of the address, which occupied two hours, and was repeatedly applauded, a vote of thanks was enthusiastically accorded to the lecturer on the motion of the chairman.