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INTERESTING DISCUSSION ON DARWIN'S THEORY.

No subject can be more worthy of the interest which it invariably excites than DARWIN'S combined theories of successive slight variation of animal and vegetable form, and the theory of natural selection, according to which the form most perfect, or most suitable for the existing circumstances, gets the upper hand and possibly exterminates other forms. Given a single form of life, different individuals possessing it may be placed in varied circumstances of sea or atmosphere. In the course of growth, slight varieties of form may thus arise, and be transmitted at the birth of new generations. Many such slight variations being, one after another, impressed upon the same original form, a new form will, at last, be produced, bearing but a very slight or inappreciable resemblance to the original.

Again, as each new generation of an animal or plant tend to become as many times more numerous than the last, as that was more numerous than the last but one, the number of individual which can ultimately be produced is indefinite. But the very air and sea, though great, are limited; still more limited is the food appropriate for nourishing animals or vegetables. Hence it is impossible that all individuals that are born, or might be born, should live, and in the struggle which ensue, any variety of animal or vegetable form which possesses superiority to other forms, as regards existing circumstances, will predominate. Thus is explained the upward progress of animal creation which ends in Man.

DARWIN supports these theories by many facts, such as the well-known variations which take place in domestic animals or cultivated plants, the series of analogous forms of life which geological history affords, and, as regards natural selection, the known instances in which one race of animals eats up another, or a single kind of plants spreads over the land and smothers out many others.

Charges of false reasoning having been brought against this theory (there are in reality two distinct theories), a discourse was delivered in the Zoological Section of the Association on Saturday, attempting to vindicate the method of investigation used by Mr. DARWIN, as being in strict accordance with logical principles. The audience was large, and deeply interested. The speaker, Mr. H. FAWCETT, having unfortunately lost his eyesight by a gun accident, requested permission to dispense with a written paper, and then delivered a remarkably clear and consecutive speech, of which the following is a summary:—

The discussion at the last meeting of the Association was briefly described. The Bishop of OXFORD then attempted to treat the theory as no theory at all, and as worthy only to be ignored. The principal scientific opponent, however, was OWEN, supported by SEDGWICK and HOPKINS, while DARWIN'S side was warmly taken by HUXLEY and HOOKER. The importance of the theory was evident from the fact that most physiologists had ranged themselves either in the DARWIN or the anti-DARWIN faction. The charge against DARWIN, said Mr. FAWCETT, now is that he does not follow in the footsteps of KEPLER and NEWTON, or observe the Baconian canons of induction, by collecting facts and by arrangement and generalisation evolving some universal certain law. DARWIN, on the contrary, evolves an hypothesis from his own head, and states it, against many contradictions, as a theory. It is here maintained, that whatever be the validity of the theory, DARWIN'S method is that which must be adopted in a subject of this kind. If DARWIN'S theory were disproved to-morrow, it is by DARWIN'S modes of thought that we should have to look for a new theory.

In later years it has been correctly held that pure induction, or the mere collection and arrangement of facts, is incapable of reaching the higher rank of truths. BACON displaced the useless pure deductive logic of the Schoolmen by pure induction, but the ablest living logician, JOHN STUART MILL, has held that a reaction must take place (rather say that BACON'S substitution never was complete), and that it is combined induction and deduction which leads us gradually up to approximate certainty. Reasoning on physical subjects, then, consists of three steps:

1. Induction, more or less perfect, suggests an hypothesis.
2. Deductions are drawn from that hypothesis.
3. These deductions are compared with other known facts, and verified.

In proportion as this comparison and verification of an hypothesis is extensive and favourable, does the hypothesis advance to the rank of an established or morally certain theory. Even NEWTON thus cast about in his mind for some supposition to explain the heavenly motions, and the first law of gravity he used was actually wrong. But having obtained the correct law, every fresh calculation and prediction founded upon it proves correct within a quantity, of which the smallness leads us to conclude that other subordinate causes, or more accurate estimation, may explain it. Now theories, which, like that of NEWTON, deal with qualities, admit of ever-increasing mathematical accuracy and proportionate increase of probability. But the sciences differ much as to the particular mode in which the universal laws of reasoning can be applied to them. Thus, chemistry admits of unlimited experiment; physiology of but little. So DARWIN'S theory, not dealing in any measurable quantity, cannot be verified in the same manner as NEWTON'S law of gravitation. Nor does it admit of experiment for any human operation is necessarily restricted to the short span of human life, and even human observation and record, at the longest, extends only over a few thousand years. The periods, however, in which the changes of organic forms, as well as the operation of geological forces, are accomplished, so far as our present knowledge informs us, are almost indefinitely great. The prediction of an organic species is comparable with a geological revolution; and in the lower ranks of life—for instance, the mollusca—we find species remaining unaltered through many series of rocks. Yet DARWIN has undoubtedly shown that we may, by careful breeding, so alter a species that, if found in the fossil state, it would be considered a separate species from its original. Some have objected that ancient Egyptian sculptures show several animals to have had precisely the same form some thousands of years ago which they now possess. But why should they not? Do we not read in classical authors of mountains, plains, or rivers, which yet remain unaltered? Why should we insist on the dog, the cat, or the ibis being unchanged, while Mont Blanc stands unshaken?

DARWIN'S theory, then, is incapable of many kinds of proof which are looked for in other sciences. Nothing could be more absurd than to object that he does not deal in mathematical demonstration, or try experiments which would necessarily outlast his own lifetime.

DARWIN is distinguished among scientific men for his extreme candour, and has raised objections to his own theory which others, perhaps, might not have thought of. The strongest objection yet known is that immense interruptions occur in the series of organic forms which we find in the fossil state. He does not pretend fully to explain this or all other objections, but when DARWIN'S promised work containing all his detailed observations and collected facts is published, it will appear that he has been a most laborious investigator; that no one could have sought a more enlarged inductive basis of facts for his theory, so far as the logical nature of the subject allowed.

In conclusion, Mr. FAWCETT urged that the theory does not detract one iota from religious truth. Some suppose each species to be the result of a distinct creative act; but if all organisms are descended from a few primitive forms, under the influence of laws and circumstances then preordained, the interposition of Omnipotent Creative Will is equally necessary. It is the work of the human intellect to show the simplicity and perfection with which the Creator works, and it is this which DARWIN, like NEWTON, is performing.

Dr. LANKESTER then spoke for the apparent purpose of encouraging discussion. He accepts DARWIN'S facts rather than his conclusions; instead of a theory he would prefer a determination of the forces which occasion variety of form. A great naturalist has said that DARWIN deals with *origins*, but ought to give us the *facts*, and leave the rest alone. DARWIN assumes a proto-plastic form, and therein does no better than those who assume a multitude of forms. It is useless to attempt thus to go back to creation in any branch of science.

Professor WILLIAMSON, of Owens College, Manchester, said that men are battling about the origin of species when they cannot give a definition of what a species contains in. Professor OWEN even speaks in the most guarded phraseology as to what constitutes a species, and any theory on the subject must, therefore, be very vague and unsatisfactory. When a thousand remedies are proposed in medicine, we may very properly consider them all to be worthless; so it is with the innumerable arguments for or against DARWIN'S theory. The very name theory implies an established truth, but DARWIN makes nothing more than a pure hypothesis.

JOHN LUBBOCK, Esq., F.R.S., allowed with Dr. LANKESTER that we can know nothing of the first origin of life, but the first germ being given we desire to learn how a multitude of forms arise. In reply to Professor WILLIAMSON, he maintained that hypothesis and theory differ only in degree of probability, for even the best established theory is not certain. As to the argument about a thousand remedies, he thought it very similar to that of a celebrated French sceptical philosopher, who argued that because there were a hundred religions in England there could be no true one.

A Gentleman then urged that no theory can stand which opposes revealed truth, and that DARWIN'S theory must therefore fall. The President stated that theology was beyond the objects of the Association.

Professor WILLIAMSON guarded his argument from the conclusion which had been put upon it, and held that scientific truths were not comparable with those of Scripture.

Mr. FAWCETT finally replied that his positions were not assailed. We seek not the origin of life, for that is beyond us, but we seek to understand the evolution of variety from unity. It is highly unjust to bandy about charges of irreligion against the theory of a man who labours in the pure love of truth.

It may be added that the indefiniteness of the *species* above alluded to is not an objection to DARWIN'S theory, but one of the highest verifications of it. An organic form branches out into two different forms, and in some proportion to the time elapsed will be the diversity produced. But the limits of variety, species, and genus, remain utterly undetermined, and are therefore arbitrary creations of naturalists.

The very interesting nature of the telegraphic collection made by Professor CLIFTON, of Owens College, on a plan suggested by Mr. DODWELL, seems to be generally admitted. In this, the history of telegraphy is traced down from the first patent of WHEATSTONE, in 1837, through the very numerous modifications of the electric principle, down to WHEATSTONE'S most beautiful magneto-electric and automatic instruments of 1860. The original models of WATT'S great inventions in steam-engines, lent by Messrs. JAMES WATT & Co., of Soho, now in the Free-trade Hall, have likewise excited much interest. These small collections seem naturally to suggest the extreme interest which a chronological collection, illustrating the history of the principal British inventions, would certainly possess. Models, or real machines, or even drawings, showing the improvement of textile machinery, engines, canals, steamboats, railway construction, telegraphs, and a few other of the principal branches of invention, might be collected.

There are doubtless many old models or machines highly interesting and suitable for such purposes, lying neglected in the dusty corners of factories or offices. At the request of any important society, such as the Society of Arts, they would probably be sought out and lent for exhibition.

Now, if such a collection were ever undertaken, there could not be a more favourable opportunity than the spring of 1862, when so many foreigners will be in the country, and all will be inclined to see everything that is worth seeing. Such a collection would most appropriately have formed part of the Great Exhibition at Kensington, leading back the mind from the achievements of the present day to the slow steps by which they were gained. But there is no reason that the history of inventions should not be illustrated in a separate and supplementary exhibition; and, were this not undertaken in London, it would form in Manchester a most appropriate parallel to the great Exhibition of Art Treasures of 1857. Inventions are the most valuable art treasures in the world.

SECTION D.—ZOOLOGY AND BOTANY.

This section resumed its sitting, at the Royal Institution, soon after eleven o'clock, when the large room was much crowded. Professor BABINGTON presided.

MR. DARWIN ON SPECIES: HIS METHOD.

Mr. H. FAWCETT made a communication "On the method of Mr. Darwin, in his treatise on the origin of species." He said that, as he could not conform to what he believed was the rule, that communications should be read (Mr. Fawcett being blind), he would promise to keep as close to his subject as though he had written his paper. The title which he originally fixed upon was, "That the method of investigation pursued by Mr. Darwin, in his treatise on the origin of species, is in strict accordance with the principles of logic." He feared that he might be charged with presumption in attempting to say anything on Mr. Darwin's great work, which had already engaged the attention of the most accomplished naturalists of the day. He had been assured that the discussion on the subject at the last meeting of the Association had never been surpassed in the interest it excited or in the talent which it called forth. Indeed, the work had divided the scientific world into two great sections—Darwinite and anti-Darwinite, were almost the badges of opposite parties. Professor Owen, Professor Sedgwick, and Mr. Hopkins had given to the new theory a decided opposition; Sir Charles Lyell, Professor Huxley, and Dr. Hooker had given to it a support more or less decided. All who took an interest in the subject had a right to inquire whether the theory—whatever might be thought of its details—had been logically brought forward. The province of logic was not to discover new facts, but to decide whether facts were legitimately used to establish that which it was pretended they proved. It was constantly alleged that Mr. Darwin was illogical; that he had not followed the Baconian method. The *Quarterly Review* assured us that Mr. Darwin had not followed in the steps of Newton and of Kepler; but nothing was more easy than to make such charges, which often only concealed pretentious assumptions of scientific knowledge. It was more pertinent to inquire — What is the method of solution of which such a problem admits? He insisted that if ever solved it could only be by a method analogous to

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that attempted by Mr. Darwin. It could only be solved in this way:—An hypothesis, resting upon more or less perfect induction, must be started; from that hypothesis certain deductions must be drawn; these deductions must be tried, by seeing whether they would explain the phenomena of nature, and they must be verified by seeing whether they agreed with what can be observed in nature. If this explanation and verification was complete, the hypothesis was advanced from an unproved to the position of a proved and established theory. The Bishop of Oxford last night said that the theory was so absurd that no scientific man could for a moment think that it was in any degree worth considering. But Dr. Hooker, than whom a more eminent authority could not be quoted, at once disposed of the Bishop, by saying that as he believed the theory worth considering, he ought to "apologise for addressing the meeting as a man of no scientific authority." Dr. Hooker added that he knew of the theory five years before; that, at first, no one more opposed it; but that five years' devotion to natural history had convinced him that the theory was worthy of the most careful consideration and examination. Mr. Darwin, with the most perfect candour, explained in his work that his theory did not yet explain all the facts of nature; but it must not be supposed that his twenty years' labour had done nothing to advance the ends of science. Mr. Darwin had strictly followed the rules of the deductive method as laid down by John Stewart Mill. When Kepler inferred his law of the connection between the major axis of the planets and the times of their revolution, he so inferred from observation, which he could strictly verify by mathematical calculation. The origin of species does not admit of such a verification. In chemistry there was much more power of proof or verification by experiment than was possible in physiology; so with other sciences. When laws of nature can not be discovered by experiment, we are obliged to go to deductive reasoning. Newton had not only an hypothesis, and not a theory, to the law of gravitation; the law he first tried was an incorrect one. He tried again; and then, as Professor Whewell said, by a tentative process he discovered the correct law. Mr. Darwin had told him (the speaker) that his hypothesis was not at once suggested to him. He found in his studies that there was something wanted to explain many of the observed phenomena; years passed, and at length his hypothesis was very indirectly suggested—for he said that it came from reading Malthus's Essay on Population. Twenty years of unremitting labour he had devoted to the endeavour to verify the conclusions which might be deduced from this hypothesis by the facts observable in nature. He believed that Mr. Darwin's second work, for which the author had accumulated a great mass of knowledge, would prove beyond doubt that no one could have been a more conscientious or laborious observer than he had been. Newton could verify his hypothesis by the simplest experiment—he had but to drop a stone from a tower and to note the time occupied in its descent. But the problem of the origin of species is concerned with an epoch of time associated with geological epochs; therefore, experiment could only be made during so short a time, that nothing more could be obtained than an argument resting on a, comparatively speaking, unsatisfactory analogy. Darwin had been able to show that by a system of artificial natural selection two organisms, originally descended from the same form, could be made to differ so much that if they were found as fossils they would undoubtedly be classed as distinct species; and, therefore, how a morphological species could be produced. But his experiments had failed to show how a physiological species could be produced; for no one could show that two varieties from the same form could be made to differ so much that they would possess the quality of infertility. This was too often forgotten by objectors. The Egyptian sculptures were pointed to to prove that during 3,000 years the causes looked to by Darwin had done nothing to alter the form of animals. But what would be said to him who, by discovering that 3,000 years ago Mont Blanc was of the same altitude as now, should think that he had thus disposed of the theories of modern geology, that the stupendous peaks of Switzerland were lifted from their ocean bed, and that every change on the surface of the earth had been produced by an indefinite continuation of physical causes which are in ceaseless operation?—(Applause.) Mr. Darwin admitted that geology did not show that in animal life there had been those transitional links that ought to exist according to his theory, and according to any other of gradual transmutation. He (the author) could not see that this theory detracted one iota from any of the attributes of the Creator. If we supposed that the introduction of every new species required a distinctive act of creative will, then, of course, the Creator must have interposed everytime a new species was introduced. But, if we supposed that every living organism has descended from those forms in which life was first placed upon this planet, it does not in the slightest degree dispense with the necessity of supposing that life could only first be so placed by the act of Omnipotent Creative Will. It was a favourite illustration in religious works, the discovery of Newton, which explains how planetary motions are produced; and he (Mr. Fawcett) believed that if ever the day came when the origin of species should be explained in fulness and simplicity, he who so explained it would be considered not only to have advanced science, but to have conferred a benefit upon religion. The attackers of Darwin forget that he has not attempted to displace a theory received as right, but merely to throw some light where all before was dark. We should, therefore, be all the more ready to welcome the conscientious labours of one who like Mr. Darwin had unremittingly devoted himself to explain to some extent what had been aptly termed the "mystery of mysteries."

Dr. LANKESTER thought that the discussion of Darwin's theory might be attended with great advantage to natural history. The facts brought forward in support of the hypothesis had a very different value indeed from that of the hypothesis.—(Hear, hear.) He believed that those who had supported Mr. Darwin had done so rather on the ground that his hypothesis had been a method of eliciting, arranging, and classifying a certain set of facts, than as believing that those facts led to the necessary acceptance of the hypothesis. There had never been an accepted theory of the origin of species; Mr. Darwin's strongest opponent could not pretend the contrary. But Darwin had no further evidence of the creation of one particular protoplast than any of the older naturalists had of the separate creation of a multitude of them. Persons were getting too much to mis-estimate the value of forms. They did not recollect that every departure had been produced by some physical law—by some force operating upon that particular form; and that it was necessary to study what had been the external circumstances producing that change, whether the distinct origin of species was believed in or not. A great naturalist, who was still a friend of Mr. Darwin, once said to him (Dr. Lankester): "The mistake is, that Darwin has dealt with origin. Why did he not put his facts before us, and let them rest?" He believed that that was where the public were in errors—in supposing that these facts explained the origin of species. Professor WILLIAMSON said that he would fearlessly challenge the whole of Europe to answer a question the settlement of which was a necessary preliminary to the discussion of this matter. "What is a species?"—(Hear, hear.) He believed that it would be impossible to reduce the arguments for and against Mr. Darwin to two points of departure for discussion. He knew nothing further from being entitled to rank as a theory than the conclusions to which Mr. Darwin had arrived; and while he would not say that Mr. Darwin's book had caused him a loss of reputation, he was sure that it had not caused a gain.—Mr. LUBBOCK thought that there had been an advance upon the question; for, while last year the discussion was objected to on a fundamental point, now credit was given to Mr. Darwin for work done, and only his conclusions were objected to.—The Right Hon. JOSEPH R. NAPIER said that his objection was, that Mr. Darwin put forward facts to contradict what we knew of the origin of life. When he (Mr. Napier) was told by the Word of God that God breathed into man's nostrils the breath of life; and when he found that our Lord referred back to the Creation——A MEMBER objected that the right honourable gentleman was going into a theological discussion, which was misplaced.—Mr. NAPIER: I was going to speak closely to the question. If the hypothesis is put forth to contradict facts, and the averments are contrary to the Word of God, I say that it is not a logical argument.—The CHAIRMAN said he was sorry to interfere; but they were met for scientific, not theological discussion.—Mr. NAPIER contended that Darwin had got no further than mere suppositions, proving nothing; therefore what was called his method was not logical. He certainly supposed that, in a country like ours, a man was at liberty to say that to bring forward an hypothesis contradicting the plain averments of Divine truth could not be a logical argument. Darwin confounded modification with advancement. You might go on modifying, without showing advancement. He thought that no more sound objection to the so-called theory could be urged than that it embraced nothing but the suppositions of a human being, in contradiction to the plain word of God.—Professor WILLIAMSON hoped that that would not be supposed that any irreligious tendency was implied by the objection taken to the line of argument of the last speaker. No one more fully felt the propriety of such arguments in their proper place than he himself.—Mr. J. G. JEFFREYS said that geologists were well aware that in the upper tertiaries, the period of which extended over thousands, nay millions, of years, the remains of animals were found agreeing in the most critical particulars with those of others still existing in our own seas. The great value of Mr. Darwin's hypothesis was to excite naturalists to continue their researches, so that they might hereafter arrive at more definite conclusions than were now possible.—Mr. FAWCETT said that after the discussion, he thought Mr. Darwin might be consoled by the conviction that the British Association considered that he was pursuing a perfectly philosophical and logically correct method, and was doing everything a man could do to establish a theory on the subject of the origin of species.

In the production of "The Power of Movement in Plants" (London: John Murray) Mr. Darwin has had the assistance of his son, Mr. Francis Darwin. Although it is not likely to achieve anything approximating the popularity of "The Origin of Species," no more extraordinary work is associated with the name of the distinguished advocate of the theory of descent. The attribution of carnivorous powers to certain plants surprised many people; but the discovery that all plants are endowed with something analogous to the brain of the lower animals will be still more startling. Indeed, as a German feuilletonist puts it, just as Mr. Darwin's earlier work tended to show that the difference between man and the lower animals is quantitative rather than qualitative, so the present work seems to demonstrate that the difference between the lower animals and plants is also in all respects merely one of degree. Plants are continually in motion, and some of their movements are not only directed by something situated only in a given part of the plant, but they are varied in obedience to the law of self-preservation, they are independent of such outside influences as light and the pressure of gravity, and they can even exerted in opposition to those forces. The results have been arrived at by means of a surprising number of experiments, performed and described with a patience which will exhaust that of the great majority of readers. For the convenience of the latter, however, each chapter is interspersed with summaries of the observations, printed in larger type than the detailed portions, and the whole work is summed up in a concluding chapter written in Mr. Darwin's usually clear and interesting manner. The ordinary movements of plants were observed by means of plates of smoked glass on which the growing roots traced their own movements, and by means of light threads of glass fastened as indicating arms to the stems and leaves and observed through plates of transparent glass. A dot was made on the latter opposite the ends of the pointers at intervals, and the dots were then connected by straight lines drawn from the first to the second, and so on. It was thus shown that every part of the plants, the roots, stems, twigs, and leaves, continually endeavoured to perform a gyratory movement, of which the drawings on the glass were diagrams more or less proportion to the length of the indicators. These diagrams have been reproduced in the volume. The movement in question may be regarded as the fundamental movement which has differentiated in various ways to serve the life of the plant. There are various special movements; some plants move towards the light, others away from it; there is apparently a mysterious response to the influence of gravitation, resulting in the roots and some stems turning towards the centre of the earth or from it as the case may be; other plants assume given positions with the approach of night, that is they go to sleep, and they do this apparently by an inherited tendency irrespective of the presence or absence of light. Plants also assume various positions at right angles or otherwise to the rays of light. That these phenomena, though associated with outside influences, are apparently not mechanically dependent upon them, is a very important advance made by Mr. Darwin on the opinions previously held by students of botanical physiology. The most remarkable of all the experiments, however, were those made with the growing radicles of seedlings suspended over water inside glass vessels. The movements of these radicles were seen to be "determined by the tip." So long as the tip was preserved the radicle behaved, so to speak, in a rational manner; when the tip was removed it became the mere slave of mechanic forces until the tip had been reproduced. "If the tip be lightly pressed, or burnt, or cut, it transmits an influence to the upper adjoining part, causing it to bend away from the affected side; and what is still more surprising, the tip can distinguish between a slightly harder and a softer object by which it is simultaneously pressed on both sides." This was shown by fixing minute pieces of paper of different thicknesses on each side. But while the tip turns from an object, "if the radicle is pressed by a similar object a little above the tip the pressed part does not transmit any influence to the more distant parts, but bends abruptly towards the object," this bend being seemingly due merely to arrested growth on the side pressed. The tip of the radicle is alone sensible to the attraction of gravity, and hence, says Mr. Darwin, "gravity does not appear to act in a more direct manner upon a radicle than it does on any lowly organised animal, which moves away when it feels some weight or pressure." We have said enough to justify our statement about the remarkable character of this book, and must send our readers to its pages if they would have their incredulity removed.

Manchester Guardian

We have before us a number of books relating

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