F.R.S., Professor of Geology and Mineralogy in the University of Oxford, and late President of the Geological Society; subject—"The Succession of Life on the Earth." The Vice-Chancellor, and the Masters of St. Catharine's, St. Peter's, Trinity Hall, Clare, St. John's, Sidney, &c., and a large number of resident members of the University were present; and accommodation was afforded for ladies and strangers on the floor of the Senate-house: the galleries, as usual, being occupied by undergraduates.

The Lecturer commenced by observing that the subject which, by the Vice-Chancellor's command, he had the gratification of bringing before their notice, could claim in no other manner the character of being new, except in being at the present time subjected to that scrutiny which always arises on the production of new evidence; for certainly the history of life and the ideas which could never be absent from the mind of any contemplative naturalist. It never could have been absent, because in all the classifications, in all the systems by which we vainly task ourselves to retain the divine idea of nature, we have invariably looked for a beginning, a progress, and a possible end, and looked for a beginning, a progress, and a possible end, and looked for such rudimentary history, and the course of life have enabled us to gain a view of, according to the measure of the knowledge of the time. All nature had been found to be harmonised and linked together, point to point, by one beautiful and successive law; and perceiving as we do, that every one thing is planned for a definite purpose, everything being thus manifestly linked together, the idea is conveyed that so perfect a plan must be permanent and subject to no material changes; yet in every stage we perceived vicissitudes from the greater to the less, and from the less to the greater; from the simple to the complex, and from the complex to the simple. This consideration made the study of nature hopeful. We might never fathom the mystery or take the origin of life or of nature, but every step we take brought us towards a better understanding of the problem, and was a step in the right direction. Let us, then, take into consideration the subject of the history of the earth, not with an idea that we can altogether solve the problem, but to get a further insight into it, a further perception of the laws of nature, by the use of those senses with which the Almighty has endowed us. It would be necessary to speak of the character of the dependance of vital phenomena: life, as they were aware, existed only in certain sorts and certain combinations of matter. It might be said that it was possible for the Almighty to exhibit life in other sorts and combinations of matter; but this was not the question. Now, life was co-ordinate, dependent on its atmosphere. Plants and animals were dependent on this atmosphere, and those components of it which were exhaled by the one were respired by the other. So life was co-ordinate; and as plants fed on the atmosphere, they in their turn furnished food for the animals. This air was necessary for life and also for sight. How admirable was the adaptation of the human eye to the human mind. So also was the eye of the bird, the quadruped, the whale, and the fish, adapted by the Creator to every purpose for which it was necessary to enjoy this wonderful organ. Now life was subject to all these conditions. It was subject likewise to a very remarkable law, that every individual in which life is manifested is subject to a determinate duration, and the forms of life are reproduced after the pattern that was the original, with slight variations of the same type. In order to give an idea of the great richness of the subject, he would mention one, or two things touching the limitation of the forms of life. Among other things that greatly limit the forms of life is temperature. If they drew a line round the earth parallel to the equator, they would enclose a zone in which certain forms of life were visible; drawing a line further north, they would find that as they proceeded these forms of life gradually diminish, and the plants and animals of the torrid zone gave place to those of temperate regions, which in their turn were succeeded by the productions of the frozen zone. If they carried up a high mountain, they would find all these symptoms of change. At the base the plants of the country would grow; as they proceeded these diminished; and they found further up those of a colder region, until the summit was clad in perpetual snow. Thus they saw that certain ranges of temperature were necessary to life. The same law governed the inmates of the sea. Professor Edward Forbes probed the depths of the Ægean sea, and found that the quantities of life continually diminish from the surface downwards. Down to the depth of 230 fathoms the proportions of quantities were as follows—100, 161, 154, 91, 90, 33, 6, 0. So the scale of life passed at the maximum above the surface to a minimum at a certain depth below. He now asked them to consider the question of the distinction of the forms of life. Take a circular diagram, representing the earth, and draw across it lines of temperature, we find it possible to represent them. Then in the region nearer the equator we found the larger carnivora, further north graminivora, and so on; and as in the new world certain forms of life corresponded to certain physical conditions, so it was in the old world. When we traced that subject out we acquired an idea of the convergence of life. He knew, up to that time, what he had said could have no novelty; and when speaking of geology and matters of that nature, he could not fail to remember that he had a precursor in the noblest of England's geologists, their pride and his friend Professor Sedgwick, who had applied the proceeding to the question of the succession of life on the globe, the lecturer spoke of four main types of the forms of life, viz., the radiating, the articulating, the molluscous, and the vertebrated animals, and of the adaptation of their structure. Three of these great types were formed for land, and moving through the air and on the land or through water. He then showed that many of the same forms and conditions of life existed now as in the earlier systems of nature, subject, of course, to certain vicissitudes with the earth's surface. It was impossible to determine the commencement, speaking in terms of geological time, of the forms of life. Let us suppose that we had the power of excavating the subterranean records of life. Below the surface at the depth of a few feet we should find elephants, mastodons, and hippotamus, and creatures which now only existed in the tropics. Lower down we should trace of the forms of quadrupeds, and found no remnants of animals at all. As we passed down, we found three great groups of stratification and three great groups of organization: we were passing down from the more recent to the ancient, and we had therefore a history if not a chronology of the earth, the variety of all this deposits being marked according to time. The lecturer, by a series of diagrams, illustrated the classification of these varieties; the three great divisions of caracoids occupied by mammalia; mesozoic, by reptiles; and palæozoic, by trilobites, and ranging under subdivided. In this manner there was a classification, one another began, and thus were traced the successions of life; each of these periods being as distinctly marked as eras of history. Then arose the question, is there a point of geological time which can be reached and which being reached we are justified in believing there were no traces of life on the globe. This was a serious investigation, and one that required a great deal of consideration. As we descended through these stratifications, undoubtedly the number of the forms of life diminish, until from thousands we found hundreds, then tens, and ultimately no traces of life remained. The learned Professor traced the progress of various genera through the tertiary, cretaceous, colitic, saliferous, carboniferous, silurian, &c., strata, represented on the diagram by a band of diminishing thickness, until a zero was arrived at. In the same way certain species of molluscs were gradually diminished in the strata until the zero of geological life was arrived at. He proved that while some groups of life were predominant in the old system of things, others just made their appearance in the ancient system of strata, and went on augmenting until they occupied the greater proportion among human things. He spoke of the perpetuity of certain types of forms, and of the existence of analogous productions on the earth and beneath its surface, though in widely separated latitudes. Thus for instance marian deposits and certain types of insectivorous tribes had been found at Stonesfield, corresponding to those now existing at New Holland. In some parts of Australia, on the land we found plants which had deposits among the remains at Stonesfield; and on the coast of Australia there was a shark with teeth of a peculiar formation, and teeth precisely similar were dug up at Stonesfield. The lecturer proceeded to argue from the facts laid down that the Darwin theory of natural selection, and the development of life from one original type, has no foundation to rest upon. He dwelt upon the fact that geology reveals no evidence whatever of transition from one species to another, and ridiculed the action of any such power of change dependent upon the creature and external circumstances as would enable a rook to develope itself into a heron. Geology furnished no data to support the hypothesis that one set of forms of life could be transformed into another. The argument to be good for anything should show us one set of forms of life gradually dying out, and another gradually coming in, by this process of "natural selection." But there was nothing of the sort—no branching off—no evidence whatever that one grand group of life was derived from another of a different form and a different date. In conclusion, he said, that whatever researches had been made, however the science of geology had been developed, no new conclusion had been arrived at beyond this, that we have successive forms of life suited to the successive ages of the world, and all are the creation of one Almighty hand for some wise and useful purpose.

The meeting then broke up.

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MR. DARWIN AND HIS WORK.

BY PROF. E. L. YOUMANS.

THERE is just out a new American edition of Darwin's *Origin of Species*, with the latest corrections and additions of the author. This is the fifth revision since the publication of the work eleven years ago, and shows that the public interest aroused upon its first appearance has not abated but is still keen for every new contribution to the question. We shall possibly have to make up our minds after all that the *Origin of Species* is destined to a permanent place in the literature of science, if not indeed to take rank as a book that marks an epoch in the progress of our knowledge of nature. Such a book was Copernicus' *Revolutions of the Celestial Orbs*, which signalled the rise of modern astronomy. A book of this kind was Hutton's *Theory of the Earth*, which foreshadowed modern geology, and if it may seem presuming to name the *Origin of Species* in connection with works of such historic renown, I have only to say that it is done by those best qualified to judge,—the highest living authorities in natural history having characterized it as the *New Organon of Biology*.

It will not be uninstructive to dwell a little upon this circumstance of the reception which has been accorded to Mr. Darwin's views, and to note how they are regarded after ten years trial. That the public mind was thoroughly ripe for them, and quickly seized all the implications of the case, is shown by the fact that the critical battle burst into perfect fury upon the first publication of the book. It was quickly translated into nine foreign languages, and the fierceness of the controversy that followed showed that something beside the lower animals had entered upon the "struggle for existence." The antagonism was at first almost universal. The great majority of scientific men shrugged their shoulders and pronounced it unsound science and bad philosophy, while the official cardinal-kers of the Divine Government thundered their anathemas against the new-fangled treason, which threatened, it was said, to vacate the universe of its Ruler, and to degrade man into a beast. The attitude of the extreme opposition was well illustrated by an Edinburgh Free Church Professor, who said in a lecture "he should not shrink from calling it (the development theory) by its right name, and asked why they should be charged with a want of charity and with being the victims of theological bias, in saying that it was downright dark, dreary atheism. Human ingenuity had never been able to adduce one fact in support of this wretched theory. It was trifling with human intelligence to propose it. It was an outrage on common sense to ask us to ponder it." It is said to be hard work to "kick against nothing," and if so, the vigorous Professor must have wrenched himself badly in the six long lectures he gave in reply to these unsubstantial and groundless views.

Meantime with that considerable class whose business is investigation for truth's sake alone, Mr. Darwin's doctrines began rapidly to grow in favor. Honestly questioned at first they were subject to sharp critical scrutiny, and then began to be accepted with equal candor. The history of the human mind in its research into the order of nature furnishes no instance so remarkable as this of opinions at first decisively rejected as erroneous and obnoxious, and then so widely and promptly accepted after thorough examination—no other instance so impressive of that triumph over prejudice and surrender of life-long opinions when shown to be untenable, which is the highest result of scientific discipline. At the British Association for the advancement of science in 1859, the question became an apple of discord and roused a storm of indignant opposition; poor old Daubeny, the president being at his wits-end to regulate the turbulent conflict. On the other hand, at the recent meetings of that body, its presidents, Armstrong, Grove, and Hooker have recognized the new phase of biological inquiry and argued elaborately in favor of the advanced views; while Professor Huxley, an avowed and unqualified Darwinist, is president of the association for the present year. These views besides are more or less fully entertained by a large portion of the most intelligent membership, and notably by

In the American Association these ideas seem to have made their way more slowly. At the late meeting in Troy, however, if we are to judge by the reports, Darwin's views figured prominently. Prof. Meehan read a paper on one branch of Darwin's researches in which he had at first supposed him in error, but at last found him to be right. In the subsequent discussion, Dr. Gray the distinguished Amesican botanist declared "that he had frequently attempted to catch Darwin tripping in this particular, and had referred to him many instances which he himself at the time considered opposed to the theory; but in every case he had been forced to withdraw his objection."

The correspondent of the *Evening Post*, writing from Troy, observes: "First and foremost, we miss Agassiz, with his piquant and sometimes petulant obstinacy, and his good nature shining through it. The old man has trained a school of vigorous and independent young naturalists, who do not accept the opinions of their master. Last year, at Salem, Cope, of Philadelphia, reverentially but thoroughly floored him in debate. Verrill, Morse, and others have keenly criticised a good deal of his work; and, in short, so long as Agassiz opposes the Darwinian philosophy, those young Darwinians will make it warm for him. It is now said that Alexander Agassiz has come out on that side, and that the Professor himself is only seeking for a loophole through which he may crawl to abandon the untenable fortress which he has so long and stoutly defended. Variously explained, modified and limited,

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Darwin's philosophy will doubtless be, but overthrown it will not be."

On the continent these views are also rapidly extending. They are prominently discussed at all the scientific conventions, and it is said they have been accepted much more cordially and unqualifiedly in in Germany than in England. In 1859 Professor Gegenbauer published the "outlines of Comparative Anatomy," which has been accepted as an authoritative text book of the subject. He has this year issued a second and much enlarged edition, recast, and embodying the Darwinian philosophy. He speaks of the theory of descent with modification, through natural selection, as constituting a more important era in comparative anatomy than any other theory has ever yet done; and he regards comparative anatomy itself as one of the touchstones of its truth. Dr. Gegenbauer closes his sketch of the theories of the subject with the following words: "If we consider that the number of those who have mastered the theory and its real meanings and bearing, is though at present small, yet constantly increasing, and that, too, by accessions from the ranks of its former opponents, we begin to feel ourselves justified in looking for the accomplishment of an auspicious revolution by its means."

A distinguished example of such conversion from the ranks of the opposition is that of the eminent German naturalist, Dr. Fritz Müller, who tested Mr. Darwin's views in their application to the crustacea, as Gray had done in some branches of botany. In his German work which bears so powerfully in favor of the new views, that it has been republished in England under the suggestive title of *Facts for Darwin*, Dr. Müller says: "A false supposition, when the consequences proceeding from it are followed further and further will sooner or later tend to absurdities and palpable contradictions. During the period of tormenting doubt—and this was by no means a short one—when the pointer of the scale oscillated before me in perfect uncertainty between the *pro* and the *con*, and when any fact tending to a quick decision would have been most welcome to me, I took no small pains to detect some such contradictions among the inferences as to the class of crustacea, furnished by the Darwinean theory. But I found none either then or subsequently. Those which I thought I had found were dispelled on closer consideration, or eventually became converted into supports for Darwin's theory."

Another conspicuous example of this "coming over" of a former opponent is furnished by Sir Charles Lyell—perhaps the most learned of living geologists, and who has powerfully contributed to give that science its present shape and direction. After having studied for fifty years the subject of life in connection with the past changes of the globe, and embodied the older views in all his numerous works, he has at length, in the tenth edition of his *Principles of Geology*, abandoned the old ground as untenable, and adopted the views represented by Mr. Darwin. These are certainly curious mental phenomena to take place in relation to a theory so "wretched" that "human ingenuity has never been able to adduce one fact in support of it."

Of Mr. Darwin's views I design to make no analysis in this place, but merely to show how his work is regarded in the scientific world. But as he is one of our contemporaries whose name will unquestionably be eminent in the distant future, a few words may be added in relation to his personal history.

In the first place Mr. Darwin is a marked illustration of one of his own leading doctrines—modification by descent, or the hereditary transmission of talent, the subject which has recently received so interesting an elucidation in Mr. Galton's book on hereditary genius. His paternal grandfather, Dr. Erasmus Darwin, author of the *Botanic Garden* and the *Zoonomia* was a naturalist of considerable eminence and of a speculative turn of mind. His father was a physician and an F. R. S., while his maternal grandfather was the celebrated Josiah Wedgewood, a man of inventive genius and of much force of character, who originated the manufacture of the celebrated "Queens Ware," or "Wedgewood Ware." Prof. Silliman used to say it was a great thing to be born with a good education; Mr. Darwin had that advantage.

He was born at Shrewsbury in 1809, and attended the Shrewsbury school. He went for two years to the University of Edinburgh, and took his degree at Christ College, Cambridge, at the age of 22. His scientific acquirements were already so well known that he at once got the appointment as naturalist to accompany Captain Fitzroy of the Royal Navy in a voyage of scientific exploration round the world in H. M. S. Beagle. The expedition lasted five years, during which various countries and islands in many parts of the world were visited and their natural productions examined. The *Journal of Researches*, published after his return, established Mr. Darwin's reputation as a close cautious, accurate painstaking observer and a sound inductive reasoner. Of his numerous subsequent researches in various departments of natural history and all conducted with an accuracy and fidelity that won the admiration of his compeers, it is unnecessary here to speak. When fifty years of age he published his great work *The Origin of Species by Natural Selection*, the theory of which he had been developing for twenty years. Mr. Darwin was early elected a member of the Royal Society and has received from it the Royal medal, the Copley medal, and the Wollaston medal from the Geological Society. He has also received many honors from foreign scientific bodies.

In 1839 Mr. Darwin married his cousin, Emma Wedgewood, and shortly after took up his residence at Down, near Farnborough, in Kent. Here he has devoted himself to his favorite studies and to the care of a large family. His health was profoundly shattered during his protracted sea-voyage, from the effects of which he has never recovered; and although his labors for the last thirty years are altogether remarkable in their extent and thoroughness, they have been performed under the disadvantages of much bodily suffering and an invalid life. His friends who know the frailness of his health and the difficulty of his labors, are consequently reluctant to intrude themselves upon him.

It has been often remarked that Mr. Darwin's writings, free from every taint of egotism and arrogance, and imbued with the modesty of the genuine truth-seeker, are in these respects models honorable to science, and which his acrimonious assailants would do well to imitate. This trait of his works is genuine, and springs from the unaffected and genial spirit of the man. Leading his mental life among the profounder harmonies of living Nature, and reverent toward her beautiful order, he is content with the quiet unimpassioned statement of such glimpses into her plan as he has been permitted to make. Nor is it too much to say that this repose of feeling rises into the genuine quality of faith; a faith grounded in knowledge, but extending into the unrealized and unknown—a trusting reliance in the wisdom by which the course of things is directed. With Mr. Darwin this is more than mere aimless sentiment; it is a guiding rule of life. In the domestic sphere, in the management of his children he is said to be severely distrustful of his own meddling, and to have a profound reliance upon Nature's care, tuition and discipline. This is a practical corollary from his doctrines; for if the policy of the world is that of a mighty unfolding; the working onward forever to higher life and greater good; and this by the deepest law of things, and largely independent of human agency, the logical lesson is certainly that of diminished anxiety and increasing trust. Mr. Darwin, therefore, only applies his own philosophy in refraining from much interference, satisfied as he is that the school of experience is under a wise, strict, and all-beneficent control.

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