Art. IV.—Darwin.

1. *A Naturalist's Journal of Researches.* By Charles Darwin, M.A., LL.D., F.R.S. London: John Murray. 1845.
2. *The Structure and Distribution of Coral Reefs.* By the same. London: Smith, Elder & Co. 1874.
3. *The Origin of Species by means of Natural Selection.* By the same. London: John Murray. 1872.
4. *The Variation of Animals and Plants under Domestication.* By the same. London: John Murray. 1868.
5. *The Descent of Man and Selection in Relation to Sex.* By the same. London: John Murray. 1871.
6. *The Formation of Vegetable Mould through the Action of Worms.* By the same. London: John Murray. 1881.

On April the 19th departed this life Charles Robert Darwin, born at Shrewsbury on February the 12th, 1809, of whom it may be said truthfully—

> "He was a man take him for all in all
> We shall not look upon his like again."

A man who has been compared to Socrates, by reason of his wisdom; to Newton, because of the great revolution he wrought in science, but whose greatest praise is, that he was before and above all things *an honest man*, conscientiously scrupulous in weighing the pros and cons of every fact in connection with his theories, never blinking or concealing any adverse feature, anxious to give to every fellow-worker his full due, courting neither favour nor reward, but working for science alone, undeterred and undisturbed by the noisy denunciations of antagonists. Such a man may well be held up as an example of true greatness—a greatness far exceeding any which could possibly be won by persistent bids for public favour and popularity at the expense of truth. It is perhaps to this prominent characteristic—this honesty of purpose—that may be ascribed, at least partially, the good fortune he enjoyed in outliving the storm of invective levelled at him and at the theory he promulgated, and in being consigned in death, by the unanimous desire of the nation, to an honoured grave in that great fane reserved by Britannia for the wisest and noblest of her sons, a grave carefully and wisely selected near to those of Sir Isaac Newton and Sir John Herschel, a spot which will probably henceforth be known as the Philosophers' Corner. But who could have imagined in 1859, in the

midst of the hubbub caused by the publication of his great work, "The Origin of Species," that the much maligned author would thus receive the honour of a public funeral, and be followed to his grave with lamentations, not only by his friends, but by his opponents. That the Duke of Argyll and Canon Farrar should be found among his pall-bearers, side by side with Huxley and Sir John Lubbock, is a phenomenon creditable indeed to them, but remarkable, as showing the change wrought in a few years by the power of genius, guided by unswerving rectitude.

It behoves the reviewer to look back upon the career of this great man, and to trace through his work, sthe master mind which has impressed itself indelibly upon the nineteenth century, has forced a once hated theory upon a reluctant world, and compelled the respect and admiration even of adversaries.

Charles Robert Darwin inherited a name well-known in scientific and literary circles, for his grandfather, Erasmus Darwin, M.D., F.R.S.,* was a remarkable man in his day, and a naturalist of advanced views; it has indeed been said, not without apparent reason, that in the writings of his grandfather Charles Darwin found the germs of those theories he afterwards elaborated so skilfully. Of the works of Erasmus Darwin we intend to speak later, but in this place we may call attention to a fact frequently noticed, but never satisfactorily accounted for, that in the undoubted heredity of genius, the mantle of the great ancestor seldom falls in all its fulness upon the shoulders of the *eldest* son. Innumerable instances of this might be adduced, and in the Darwin family we find that the father of Charles Darwin, who likewise attained to the dignity M.D. and F.R.S., although he never became so well-known as his father, was the *third* son of Dr. Erasmus Darwin, and Charles Darwin himself was not the eldest son.† In his case, however, the heredity of genius was not confined to the paternal side, for his maternal grandfather was Josiah Wedgwood, the great potter and art designer. Such an ancestry could not fail to give a bent to those aspirations and ambitions which are never wholly absent from the mind of youth,

* It would indeed appear that the hereditary genius of the Darwin family can be traced farther back still, for we are told in the "Memoir of Erasmus Darwin," written by his grandson, that Robert Darwin, father of Erasmus, had a taste for science, and was member of the Spalding Club, his wife being a very learned lady. Their eldest son was a poet and botanist, and, when an oldish man, published his "Principia Botanica," which passed into a third edition, and contained many curious notes on biology.

† Mr. Galton's figures would seem to prove that this is by no means so commonly the case as we have supposed. Of 99 men of science, he says 22 were only sons, 26 eldest sons, 15 youngest sons. Of those neither eldest nor youngest, 13 come in the elder half of the family, 12 in the younger half, and 11 are exactly in the middle.—Francis Galton, *Men of Science.*

and which generally lead the son to adopt the profession in which his father has been successful, and Charles Darwin seems early to have decided to adopt medicine as his profession. For this purpose, on leaving the Shrewsbury Grammar School, in which his education commenced, he proceeded, in 1825, to the Edinburgh University, where he studied for two years, but at the end of that time abandoned the idea of a medical career, and proceeded to Christ's College, Cambridge, where he took his B.A. degree in 1831, and his M.A. in 1837, after his return from the memorable voyage in the *Beagle*. We do not read that the youthful student was distinguished by any notable display of genius, either at school or at college. No great flourish of trumpets heralded his entrance to the university; he does not appear to have obtained a scholarship or a fellowship, nor is he classed among the wranglers; nevertheless, even during his short connection with the University of Edinburgh, his taste for natural history and his talent for minute investigations became apparent, for we read that he was a member of the Plinian Society, which seems to have been in those days a students' debating club; and before this Society he read his first essay, on "The Ova of Flustra." That he had attained to a certain degree of fame as a naturalist before leaving Cambridge is evident, since Professor Henslow, the well-known botanist, recommended him to Captain, afterwards Admiral, Fitzroy, as fitted to hold the post of scientific naturalist on board the *Beagle*, then under orders to sail on an expedition to survey the coasts of South America and Australia. This post, ardently desired by the young naturalist, and filled in a manner beyond all praise, was entirely honorary, so much so that he was not only allowed and expected to defray his own expenses, but also to give up the whole of the invaluable collections made during the four years' voyage, to the nation, or rather to the Admiralty. Hence it will be seen, that, from the very first, Darwin's great object was the acquirement and advancement of knowledge, and not emolument or advancement for himself;* and happily for himself and for the world he was able to gratify his wishes without injury to his future prospects, for he possessed an ample fortune, which rendered a professional career unnecessary. Had this not been the case, had he been compelled to work as most young men must, in order to live, it is evident that this voyage could not have been undertaken, and the world would perhaps have lost his invaluable researches, for these,

* The great work achieved by Darwin has never met with recognition from the State; he has received many foreign honours, but from his own Government *nothing;* and only tardily, and somewhat grudgingly, did his own university bestow upon him the degree of LL.D., the undergraduates meanwhile making merry by dancing a monkey before him.

unaided by public money, could only have been carried on by one possessed of means and leisure; but how few young men, under similar circumstances, would have been ready to give up home comforts and luxuries for a life of unremunerative scientific labour and real hardship. Even in our own day, when science has made such great strides, and has become *popular*, such self-denying work is not often undertaken by men of fortune. Fifty years ago, such a scientific worker was indeed a phenomenon, and the gratification of his wish cost the enthusiast dear, for from the date of the commencement of the voyage in December, 1831, to its end in 1836, he suffered constantly and alarmingly from sea-sickness, the effects of which rendered him an invalid for the remainder of his life, making retirement and a comparative absence of excitement imperatively necessary, and again, fortunately for himself and for the world, these essentials to life and happiness were at his command.* After the memorable voyage in the *Beagle*, which extended round the world, and occupied nearly five years, he returned to England in October, 1836. In the succeeding year he took his M.A. degree at Cambridge, and it is not a little remarkable that his first recorded paper after his return, read before the Geological Society in November, 1837, should have been "On the Formation of Vegetable Mould," whilst his latest publication is "The Formation of Vegetable Mould through the Action of Worms, with Observations on their Habits," issued in 1881, thus showing that his patient attention through more than forty-four years had been directed to those lowly organisms, so often avoided with a sort of undefined contemptuous loathing, but of which he has proved the inconceivable utility in spreading beauty and fertility over the world.

In 1839 Mr. Darwin married his cousin, Miss Emma Wedgwood. "One touch of Nature makes the whole world kin" wrote the great poet, and it is not without a certain satisfaction that we see the great philosopher casting aside the popular doctrine concerning cousin-marriages at the promptings of the affections. He saw in his cousin the congenial helpmeet he required, and did not allow that doctrine to stand in the way of happiness; and certainly, as far as the outside world can judge, his married life has been of that peaceful perfect kind, too rare among mankind in general, and rarer still among those whose lives are brought prominently before the public. We may add that his children,

* There is something pathetic in his advice to travellers on this point. He says: "If a person suffer much from sea-sickness, let him weigh it heavily in the balance. I speak from experience; it is no trifling evil cured in a week."—*Journal of Researches*, p. 502.

as is well-known, show no signs of deterioration. He leaves behind him five sons and two daughters, and of the sons, two at least have already distinguished themselves, following closely in their father's footsteps, one having been for years his secretary and coadjutor in all those wonderful and minute experiments which enrich his works.* He died surrounded by those he loved, after so short an illness that the public knew nothing of it. There were no special telegrams, no messages from crowned heads, no anxious crowds to read the daily bulletins, but suddenly the world was startled by the announcement that Darwin had been dead for some hours. His death, however, does not seem to have been so sudden as it appeared to the public, for we are told that he had been ill for some days, although probably illness in a man who was always an invalid did not seem so alarming as it would have done, had he been in robust health previously. From the time of his return home after the voyage in the *Beagle*, he suffered constantly from attacks of nausea, which nothing seemed to cure, although they were alleviated from time to time by medicines and various appliances; he also derived benefit from a course of hydropathy at Malvern, continued afterwards at home, but the stomach never regained its healthy tone, and he may be truly regarded as a martyr to the pursuit of science. The letter from Admiral Stokes, published in the *Standard*, shows how much he suffered at sea, and the preface to his book on "Coral Reefs," published in 1874, records that its publication was delayed for two years in consequence of ill-health. Yet that he never regretted this sacrifice of health in the cause of science, his words in this same preface prove. "Having," he writes, "in former publications had the pleasure of acknowledging how much I owe to Captain Fitzroy, for having permitted me to volunteer my services on board H.M.S. *Beagle*, and for his uniform kindness in giving me assistance in my researches, I can only here repeat my obligations to him."

In truth the whole course of Darwin's career turned upon this voyage. In it he collected all that varied information which he afterwards digested, amplified and brought to bear upon the theories suggested by what he had observed, and even his ill-health served to secure for him that leisure which was essential for his work. Too weak for public life, he retired soon after his marriage to his residence at Down, near Beckenham, and there, in the privacy of home life, elaborated those wonderful theories which have electrified the world; there he conducted those minute experiments upon worms and plants, which have so

* This son, Mr. Francis Darwin, has since been elected F.R.S., being the fourth generation in the family attaining to that honour.

wonderfully elucidated his doctrines, and rendered his works so valuable; and there, after fifty years of scientific work, continued even to the last, he died surrounded by his family, and retaining all his faculties to the end.

He seldom quitted the retirement he had chosen, but his extreme kindness and courtesy to all who sought his help is well known, and of the charm of his manner towards strangers the *Standard* speaks thus:—"Enthusiastic pilgrims came from all parts of the world on the chance of speaking to him, and so affably were they received that, if they arrived doubters, the chances were, that they left him Darwinians." Whilst Mr. Galton, writing from intimate friendship, denominates him the Aristotle of our days, whom all scientific men reverence and love; and his biographer, in *Nature*, says: "Even greater than the wonderful intellect was the character of the man," but, whilst pointing out the necessity of a biography of such a man, in order to give the world an idea of what he was, he adds: "This, unfortunately, is just the point where all his biographers must necessarily fail. For whilst to those favoured few who were on terms of intimate friendship with him, any language by which it is sought to portray his character must seem inadequate, to everyone else the same language must appear the result of enthusiastic admiration, finding vent in extravagant panegyric."*

The life of Darwin is an epic. The object of his highest aspirations—of his earnest and diligent pursuit—was truth. He followed ever where she led, or seemed to lead, and even when the path diverged from the beaten track and became entangled with briars and thorns, he still pushed on, undeterred by perils, seeing the beacon light afar. Luxury and ease invited him, but he rejected their allurements, and still pressed on. Enemies opposed his progress and assailed him with every weapon in their power, but, like a skilful general, he allowed them to spend their strength in vain upon a fortress which he knew to be impregnable, and he triumphed. Yet, even in the hour of triumph, he never lost that modesty which is the finest attribute of a seeker after truth; and even his bitterest enemy could never accuse him of arrogance or discourtesy.

Into the inner thoughts and feelings of so blameless a character we have no right and no desire to intrude; his religious and his political opinions do not concern us; they must be left for those nearest and dearest to him to reveal or to conceal, as they may see fit. For us, the man lives in his works, and through those we must endeavour to trace him, a task by no means easy, for although his writings are not

* *Nature*, May 18, 1882.

voluminous, and although the style is easy and the meaning clear, still they cover such an immense scientific area, and are so pregnant with facts and deductions, that it is with a feeling akin to despair that we endeavour to present, within the limits of a review article, a readable synopsis of his views. We must perforce follow him into the domain of so many of the *ologies* that if we sometimes stumble we may confidently sue for pardon, since we cannot hope to approach to so great a man in universal knowledge. In truth, it seems somewhat difficult to give him his precise standing in the scientific world. He was pre-eminent as a zoologist, but he was almost equally great as a botanist and as a geologist. His earlier works were zoological, geological and palæontological, his later, zoological and botanical. That which may be termed the *Beagle* literature commenced with the fine work entitled, "Zoology of the Voyage of H.M.S. *Beagle*," published in 1838-40, towards the publication of which the Lords of the Treasury voted a thousand pounds. Had it stood alone, it would have been a lasting monument of the industry and ability of the youthful naturalist. It is divided into five parts:— I. Fossil Mammalia of South America; II. Living Mammalia; III. Birds; IV. Fishes; V. Reptiles; all collected by Darwin during this voyage, their habits, geographical range and other peculiarities being described by him, whilst Professor Owen gives the scientific description of the fossils, Mr. Waterhouse that of the living mammals, Gould that of the birds, Rev. L. Jenyns that of the fishes, and Mr. Bell that of the reptiles.

Regarding the fossils, Professor Owen says, after pointing out that previously only three species of mastodon and the megatherium were known as having been brought from South America:—

"The abundance and variety of the osseous remains of extinct mammalia in South America are amply attested by the materials for the following description, collected by one individual, whose sphere of observation was limited to a comparatively small part of South America; and the future traveller may fairly hope for similar success, if he bring to the search the same zeal and tact which distinguish the gentleman to whom oryctological science is indebted for such novel and valuable accessions.

"It is remarkable that all the fossils collected by Mr. Darwin belong to herbivorous species of mammalia, generally of large size. The greater part are referable to the order which Cuvier has called Edentata, and belong to that subdivision of the order Dasypodidæ which is characterized by having perfect and sometimes complex molar teeth, and an external osseous and tesselated coat of mail. The megatherium is the giant of this tribe, which at the present day is exclusively represented by South American species, the largest

(Dasypus Gigas, Cuvier) not exceeding the size of a hog. The hiatus between this living species and the megatherium is filled up by a series of armadillo-like animals, indicated more or less satisfactorily by Mr. Darwin's fossils, some of which species were as large as an ox, others about the size of the American tapir. The rest of the collection belongs, with the exception of some small rodents, to the extensive and heterogeneous order Pachydermata; it includes the remains of a mastodon, of a horse, and of two large and singular aberrant forms, one of which connects the pachydermatous with the ruminant order; the other manifests a close affinity to the rodent order."*

All these Darwin shows must have lived during a very modern period in the geological history of the world. He points out that the conditions under which they were found do away with that idea of rude cataclysmal change, which was a favourite theory with geologists at the time this book was published; that, on the contrary, everything denotes tranquillity. He writes: "The only physical change since the existence of these extinct mammalia has been a small and gradual rising of the continent, but it is difficult to believe that this alone could have so greatly modified the climate as to have been the cause of the utter extermination of so many animals." Here we see the acute mind setting itself to discover the law of progression and extinction, as revealed by the series of fossil forms he had discovered, and the natural causes leading to such results; and doubtless in this pondering we find the germ of that noteworthy doctrine of evolution, which he propounded later. He saw a succession of extinct forms, evidently linking together in one continuous chain of being, extinct and living forms in the same land, and his reason refused to believe in extinction by some vast and terrible event, leading only to the new creation of similar forms on the same spot; and in working out the problem he came to the legitimate conclusion, that living forms were but the gradually modified descendants of those which had become extinct. Here then was one of the results of his voyage, the matured lessons derived therefrom appearing in that wonderful book, "The Origin of Species," where we find "A group, when it has once disappeared, never reappears—that is, its existence, as long as it lasts, is continuous. . . . . For all the species of the same group, however long it may have lasted, are the modified descendants one from the other, and all from a common progenitor."† In the same work, he relates his astonishment at finding in La Plata the tooth of a horse, with the remains of

* "Zoology of the Voyage of H.M.S. *Beagle*."
† "Origin of Species," sixth edition, p. 292.

Mastodon, Megatherium, Toxodon, and other extinct monsters, and how his astonishment ceased when it was pointed out by Professor Owen, that the horse, although so like the existing horse, belonged to an extinct species. And here we may pause a moment to note the curious fact that it is in America, rather than in Europe, that we find those missing links so necessary to fill up the numerous gaps in that chain of being, required to illustrate the evolution theory. In addition to the series of fossils brought over by Darwin, which we have commented on above, the ancestral forms of the horse have there been brought out in an almost perfect sequence; and now Professor Marsh shows us forms linking together birds and reptiles so completely, as to form a powerful argument in favour of Darwin's views.

In the second edition of the "Journal of Researches,"* published in 1845, Darwin, whose views on evolution had scarcely then become defined, when treating of the fossils of South America, says:—

"I was at first much surprised how a large quadruped, the Macrauchenia, could so lately have subsisted in lat. 49° 15′ on these wretched gravel plains, with their stunted vegetation; but the relationship of the Macrauchenia to the Guanaco, now an inhabitant of the most sterile parts, partly explains this difficulty. The relationship, though distant, between the Macrauchenia and the Guanaco, between the Toxodon and the Copybara; the closer relationship between the many extinct Edentata and the living sloths, ant-eaters, and armadillos, now so eminently characteristic of South American zoology; and the still closer relationship between the fossil and living species of Etenomys and Hydrochærus, are most interesting facts. This relationship is shown wonderfully—as wonderfully as between the fossil and extinct Marsupial animals of Australia—by the great collection lately brought to Europe from the caves of Brazil by MM. Lund and Clausen. In this collection there are extinct species of all the thirty-two genera, excepting four, of the terrestrial quadrupeds now inhabiting the provinces in which the caves occur; and the extinct species are much more numerous than those now living. There are fossil ant-eaters, armadillos, tapirs, peccaries, guanacos, opossums, and numerous South American gnawers and monkeys, and other animals. This wonderful relationship in the same continent between the dead and the living will, I do not doubt, hereafter throw more light on the appearance of organic beings on our earth, and their disappearance from it, than any other class of facts."

This close connection between recently extinct and living forms has, since these words were written, become a recognized law of being, a law which it need hardly be said is essential to

* "Journal of Researches," second edition, p. 173.

the theory of evolution, and which all recent discoveries confirm and strengthen.

There are many indications in this book (the "Journal of Researches") of the growing tendency in Darwin's mind towards the doctrine of slow development, or evolution, but it had hardly yet advanced beyond the doctrine of Lamarck. When writing of Maldonado, he describes the tucutuco, which is an animal belonging to the gnawers, with the habits of a mole, the name denoting the peculiar noise it emits. These little animals are frequently found blind, of which Darwin remarks:—

"Considering the strictly subterranean habits of the tucutuco, the blindness, though so common, cannot be a very serious evil; yet it appears strange that any animal should possess an organ frequently subject to be injured. Lamarck would have been delighted with this fact, had he known it, when speculating (probably with more truth than usual with him) on the gradually *acquired* blindness of the Aspalax, a Gnawer living underground; and of the Proteus, a reptile living in dark caverns filled with water, in both of which animals the eye is in an almost rudimentary state, and is covered by a tendinous membrane and skin. In the common mole the eye is extraordinarily small, but perfect, though many anatomists doubt whether it is connected with the true optic nerve. Its vision must certainly be imperfect, though probably useful to the animal when it leaves its burrow. In the tucutuco, which I believe never comes to the surface of the ground, the eye is rather larger, but often rendered blind and useless, though without apparently causing any inconvenience to the animal. No doubt Lamarck would have said that the tucutuco is now passing into the state of the Aspalax and Proteus."*

Thus we see in this early publication the germs of those theories which were afterwards elaborated and illustrated by a multitude of skilfully conducted experiments, by immense research and abstruse reasoning; but the "Journal" as it stands is a charming book, so full of observation, and written in a style so free from affectation, that it may be read not only with profit but with pleasure by everyone.† In this voyage nothing on land or sea, in the air above or in the depths beneath, in the present aspect, or past geological history of the lands he visited, escaped the acute eye and the logical reasoning of this accomplished naturalist. No phenomenon was too obscure for investigation, no difference in structure of rock or animated

* "Journal of Researches," p. 52.

† At the meeting of the Anthropological Institute, shortly after Darwin's death, Professor Flower, whilst alluding in feeling terms to the loss sustained by the scientific world, mentioned that at a late interview he had told Mr. Darwin that he had just been reading again his "Journal of Researches" with increased interest and pleasure, upon which Darwin replied: "I am glad of that, for I always thought it the best of my books."

being, too minute to be observed and chronicled. As we read, we marvel that so many accurate observations could possibly have been made by one man in a single voyage, during much of which he was prostrated by sea-sickness. Now it is the habits of a sea-slug, then the curious vitrified tubes formed by lightning in sand banks; now the evidences of upheaval or subsidence of continents, then the effects of cattle on vegetation—which occupy the attention of the observer. Nothing is too great or too insignificant to be noted; already he had begun to appreciate the great part which even the smallest living organisms play in the work of Nature. He collects the dust blown across the Atlantic, and examines it microscopically to find in it infusoria and "particles of stone above the thousandth of an inch square," and to speculate that such a wind might be an agent in diffusing cryptogamic plants; and the subject as given by him is so curious and interesting that we may be pardoned for quoting portions:—

"The morning before we anchored at Porto Praya (Cape de Verd Islands) I collected a little packet of this brown-coloured fine dust, which appeared to have been filtered from the wind by the gauze of the vane at the mast-head. . . . . Professor Ehrenberg finds that this dust consists in great part of infusoria with siliceous shields, and of the siliceous tissue of plants. In five little packets which I sent him he has ascertained no less than sixty-seven different organic forms. The infusoria, with the exception of two marine species, are all inhabitants of fresh water. I have found no less than fifteen different accounts of dust having fallen on vessels when far out in the Atlantic. From the direction of the wind whenever it has fallen, and from its having always fallen when the harmattan is known to raise clouds of dust high into the atmosphere, we may feel sure that it all comes from Africa. It is, however, a very singular fact that, although Professor Ehrenberg knows many species of infusoria peculiar to Africa, he finds none of these in the dust which I sent him; on the other hand, he finds in it two species which hitherto he knows as living only in South America. The dust falls in such quantities as to dirty everything on board, and to hurt people's eyes; vessels even have run on shore owing to the obscurity of the atmosphere. It has often fallen on ships when several hundred,and even more than 1,000 miles from the coast of Africa, and at points 1,600 miles distant in a north and south direction. In some dust which was collected on a vessel 300 miles from the land, I was much surprised to find particles of stone, above the thousandth part of an inch square, mixed with finer matter. After this fact one need not be suprised at the diffusion of the far lighter and smaller sporules of cryptogamic plants."*

* "Journal of Researches," p. 5.

It is this careful record of facts so apparently insignificant, this weighing of probabilities, and placing them in all their minutiæ before the reader, which constitutes the great value of Darwin's writings. We are struck with the ingenuousness with which he relates his surprise at finding things different from what he had expected according to his previous reading or preconceived opinion; and he does not slur over facts to suit his convictions, but modifies his convictions in accordance with facts. Thus, geologists at the time of the voyage of the *Beagle* were almost unanimous in ascribing all great changes in the surface of the land to cataclysms such as earthquakes, but Darwin's observations led him to the conclusion that, at least in South America, almost all geological changes had been gradual and continuous. He is constantly repeating his convictions in this matter in terms similar to the following:—

"It is impossible here to give the reasons, but I am convinced that the shingle terraces were accumulated, during the gradual elevation of the Cordillera, by the torrents delivering at successive levels their detritus on the beach-heads of long narrow arms of the sea, first high up the valleys, then lower and lower down as the land slowly rose. If this be so, and I cannot doubt it, the grand and broken chain of the Cordillera, instead of having been suddenly thrown up, as was till lately the universal, and still is the common, opinion of geologists, has been slowly upheaved in mass, in the same gradual manner as the coasts of the Atlantic and Pacific have risen within the recent period."*

In other places he points out signs of subsidence alternating with elevation several times repeated, and with long intervals between, but he always finds proof that these changes were gradual, although he does not unduly depreciate the powerful effect of earthquakes, in a land more than almost all others subject to these disturbances; and he gives the effects of earthquakes in causing elevations of several feet in different places, and describes the volcanic disturbances which accompanied these elevations, particularly those which he himself witnessed at Concepcion after the great earthquake of February 20, 1835, and afterwards described fully in vol. v. of the *Geological Transactions*, and which he sums up in the "Journal," thus:—

"From the intimate and complicated manner in which the elevatory and eruptive forces were shown to be connected during this train of phenomena, we may confidently come to the conclusion that the forces which slowly and by little starts uplift continents, and those which at successive periods pour forth volcanic matter from open orifices, are identical. From many reasons I believe that the frequent quakings of

* "Journal of Researches," p. 316.

the earth on this line of coast are caused by the rending of the strata necessarily consequent on the tension of the land when upraised, and their injection by fluidified rock. This rending and injection would, if repeated often enough—and we know that earthquakes repeatedly affect the same areas in the same manner—form a chain of hills; and the linear island of St. Mary, which was upraised thrice the height of the neighbouring country, seems to be undergoing this process. I believe that the solid axis of a mountain differs in its manner of formation from a volcanic hill only in the molten stone having been repeatedly injected instead of having been repeatedly ejected. Moreover, I believe that it is impossible to explain the structure of great mountain chains such as that of the Cordillera, where the strata, capping the injected axis of plutonic rock, have been thrown on their edges along several parallel and neighbouring lines of elevation, except on this view of the rock of the axis having been repeatedly injected, after intervals sufficiently long to allow the upper parts or wedges to cool and become solid; for if the strata had been thrown into their present highly inclined, vertical, and even inverted positions, by a single blow, the very bowels of the earth would have gushed out; and instead of beholding abrupt mountain axes of rock solidified under great pressure, deluges of lava would have flowed out at innumerable points on every line of elevation."*

Fully impressed with the general slowness and constancy of geological changes, Darwin next turned his attention to coral reefs, and set himself to discover a cause for the formation of the curious lagoon islands or atolls of the Pacific. Everybody knows that most of the innumerable islands of the Pacific are formed wholly of coral, and that many of them consist simply of a ring of coral only a few hundred yards in width, enclosing a basin of still water; these are called atolls. In some this inner watery basin contains a rocky islet, like a castle surrounded by a moat, enclosed by an encircling wall, with here and there an opening resembling gates, through which vessels may pass into the still waters of the moat-like lagoon; these are known as barrier reefs, and they sometimes enclose several rocky islets. The third class of these coral formations consist of fringing reefs, in which the corals form as it were a narrow band or fringe round the island, with a shallow lagoon between it and the shore.

Professor Huxley has described the island of Mauritius, which is surrounded by these fringing reefs, thus:—

"It is a very considerable and beautiful island, and is surrounded on all sides by a mass of coral..... If you could get upon the top of one of the peaks of the island and look down upon the Indian Ocean, you would see that the beach round the island was continued outward by a kind of shallow terrace, which is covered by the sea, and where

* "Journal of Researches," p. 312.

the sea is quite shallow; and at a distance, varying from three-quarters of a mile to a mile-and-a-half from the proper beach, you would see a line of foam, or surf, which looks most beautiful in contrast with the bright green water in the inside and the deep blue of the sea beyond. That line of surf indicates the point at which the waters of the ocean are breaking upon the coral reef which surrounds the island. You see it sweep round the island upon all sides, except where a river may chance to come down, and that always makes a gap in the shore."*

The formation of these three different classes of coral islands had always attracted the notice of travellers, but no one had attempted to give a scientific explanation of the method of their structure, nor of their variety of form, until Mr. Darwin set himself to investigate the matter.

"The earlier voyagers," he says, "fancied that the coral-building animals instinctively built up their great circles to afford themselves protection in the inner parts; but so far is this from the truth, that those massive kinds, to whose growth on the exposed outer shores the very existence of the reef depends, cannot live within the lagoon, where other delicately branching kinds flourish. Moreover, on this view, many species of distinct genera and families are supposed to combine for one end; and of such a combination not a single instance can be found in the whole course of Nature. The theory that has been most generally received is, that atolls are based on submarine craters; but when we consider the form and size of some, the number, proximity, and relative positions of others, this idea loses its plausible character; thus, Suadiva atoll is 44 geographical miles in diameter in one line, by 34 miles in another line; Rimsky is 54 by 20 miles across, and it has a strangely sinuous margin; Bow atoll is 30 miles long, and on an average only 6 in width; Menchicoff atoll consists of three atolls united or tied together. This theory, moreover, is totally inapplicable to the northern Maldiva atolls in the Indian Ocean (one of which is 88 miles in length and between 10 and 20 in breadth), for they are not bounded, like ordinary atolls, by narrow reefs, but by a vast number of separate little atolls; other little atolls rising out of the great central lagoon-like spaces. A third and better theory was advanced by Chamisso, who thought that from the corals growing more vigorously where exposed to the open sea, as undoubtedly is the case, the outer edges would grow up from the general foundation before any other part, and that this would account for the ring or cup-shaped structure. But we shall immediately see that in this, as well as in the crater theory, a most important consideration has been overlooked—namely, on what have the reef-building corals, which cannot live at a great depth, based their massive structure?"†

---

* "Coral and Coral Reefs:" a Lecture by Professor Huxley, LL.D., F.R.S.

† "Journal of Researches," p. 467.

Having thus given the views of his predecessors, Mr. Darwin proceeds to unfold his own theory, based upon the habits of the coral polyp. He shows that these creatures cannot live at a great depth—not more than twenty to thirty fathoms; therefore, that they must have found a foundation at about that depth upon which to commence their structure; that they would then build up to the surface and continue to build as high as the waters of the ocean could reach them; and he based upon this the theory that atolls represent islands which have wholly disappeared by subsidence; barrier reefs, islands a portion of which still remain above the water, but which is yet gradually sinking; and fringing reefs, islands which are in a quiescent state, or possibly rising. This theory he proves by many arguments in that elaborate treatise on "Coral and Coral Reefs," which was the result of the observations he had made during his voyage, and to it he appended a list of the corals forming these reefs, the depths at which they are found, and a calculation of the rate of their growth. The map which accompanies the work shows the different character of the reefs in all the islands of the Pacific and Indian Oceans, and proves that atolls do not surround active volcanos, such volcanos representing land in a state of upheaval, and this is at least a negative proof that atolls indicate an area of subsidence. It is obvious that, if the rate of the growth of these corals can be in any degree depended upon, we have in these atolls and encircling reefs a measure of time, for the height of these reefs from the foundation would show how long the subsided land had taken to sink to the depth indicated thereby. Huxley, treating of this matter, calculates that if the corals grow at the rate of an inch a year some of these reefs would represent 12,000 years during which time the enclosed land had been gradually sinking, but adds:—

"I believe I very much understate both the height of some of these masses, and overstate the amount which these animals can form in the course of a year, so that you might very safely double this period as the time during which the Pacific Ocean, the general state of the climate, and the sea, and the temperature, has been substantially what it is now, and yet the state of things which now obtains in the Pacific Ocean is the yesterday of the history of the life of the globe."

Darwin, in his book on the "Structure and Distribution of Coral Reefs," before alluded to (published in 1842; second edition, 1874), gives the following recapitulation of his views:—

"When the two great types of structure—namely, barrier reefs and atolls on the one hand, and fringing reefs on the other—are laid down on a map, they offer a grand and harmonious picture of the movements which the crust of the earth has undergone within a late period. We

there see vast areas rising, with volcanic matter every now and then bursting forth. We see other wide spaces sinking, without any volcanic outburst, and we may feel sure that the movement has been so slow as to have allowed the corals to grow up to the surface, and so widely extended as to have buried over the broad face of the ocean every one of those mountains above which the atolls now stand like monuments, marking the place of their burial."*

This grand and simple theory, confirmed as it is by the striking fact that in no instance is an atoll found in connection with an active volcano, and by the minor corroborative facts that trees and other objects formerly above high-water mark are now below it, was long accepted as the true solution of the curious problem offered by these singular formations; but Professor Dana, the American geologist, and later, Professor Semper, have advanced a modified theory, to which Darwin refers in the second edition of his work on "Coral Reefs," in the following terms:—

"Although I demur to some of the criticisms made by this eminent naturalist, who has examined more coral formations than almost any other man, yet I do not the less admire his work. It has also afforded me the highest satisfaction to find that he accepts the fundamental proposition that lagoon islands or atolls, and barrier reefs have been formed during periods of subsidence. . . . . On the other hand, a distinguished naturalist, Professor Semper, differs much from me, although he seems willing to admit that some atolls and barrier reefs have been formed in the manner in which I suppose."

Thus it will be seen that even opponents of Darwin's theory are constrained to admit its truth to a greater or less extent, and in fact the views they advance are simply modifications, wherein *some* atolls and barrier reefs are supposed to show signs of upheaval rather than of subsidence. Even should this prove to be correct, Darwin must still be credited as the first to have advanced views on this subject based on scientific facts, which certainly have not been disproved by more recent investigations, although their universal applicability has been objected to, and it has been asserted that he under-estimated the depth at which corals can live. Nevertheless, it will always be acknowledged, that this work upon "Coral Reefs" is the most important and interesting of the geological works resulting from the voyage of the *Beagle*.

Many years ago, in reading the lucid descriptions of these coral reefs as given by Mr. Darwin, we were struck by the similarity between these atolls and the so-called ring mountains in the moon, as seen through a good telescope. It would appear that others have also noticed the resemblance. A question on the

* "Structure and Distribution of Coral Reefs," p. 193, second edition.

subject having recently been asked in *Knowledge*, the editor of that periodical appears to think the resemblance illusory; but we cannot help fancying that the analogy is great, and that if there was ever an ocean in the moon, that there, as in the Pacific at the present day, coral polypifers built reefs around subsiding mountains, and that their skeletons remain, not only to attest the existence of an ocean now vanished, but also, that the same forces and the same forms of life formerly existed in the earth's satellite as now exist here.

"Geological Observations on Volcanic Islands, and Geological Observations on South America," published in 1844 and 1846, may be said to complete the literature of the *Beagle* expedition; but although both of these are important, we must pass them by in order to devote more space to that great work by which Darwin's name will always be known to posterity.

The "Origin of Species" first appeared in 1859, and its history, although probably well-known to most people, must be briefly recapitulated here as given in the sixth edition of the work, published in 1872. Referring as usual to that voyage in the *Beagle* so remarkable for its results, he says:—

"I was much struck with certain facts in the distribution of the organic beings inhabiting South America, and in the geological relations of the present to the past inhabitants of that continent. These facts . . . . seemed to throw some light on the origin of species—that mystery of mysteries, as it has been called by one of our greatest philosophers."

He then goes on to relate that on his return home in 1837, he set himself patiently to accumulate and reflect on all sorts of facts which could possibly have any bearing on it, adding—

"After five years' work I allowed myself to speculate on the subject, and drew up some short notes; these I enlarged in 1844 into a sketch of the conclusions which then seemed to me probable; from that period to the present day I have steadily pursued the same object. I hope that I may be excused for entering on these personal details, as I give them to show that I have not been hasty in coming to a decision. My work is now (1859) nearly finished; but as it will take me many more years to complete it, and as my health is far from strong, I have been urged to publish this abstract. I have more especially been induced to do this, as Mr. Wallace, who is now studying the natural history of the Malay Archipelago, has arrived at almost exactly the same general conclusions that I have on the origin of species. In 1858 he sent me a memoir on this subject, with a request that I would forward it to Sir Charles Lyell, who sent it to the Linnean Society, and it is published in the third volume of the Journal of that Society. Sir C. Lyell and Dr. Hooker, who both knew of my work—the latter having read my sketch of 1844—honoured me by thinking it advisable

to publish, with Mr. Wallace's excellent memoir, some brief extracts from my manuscripts."*

In this brief history of a most remarkable work, we are struck first by the patient industry of the great naturalist in devoting so many years to the accumulation of facts before attempting to give the results to the world. Twenty-two years, a year longer than the time allowed to develop the new-born babe into the full-grown man, was not considered sufficient to bring the embryonic conception of an idea to maturity. And even when by the advice of friends he was urged to publish the work elaborated with so much patience, it was only set forth in the form of an abstract, and as such necessarily imperfect.

"No one," he says, "can feel more sensible than I do of the necessity of hereafter publishing in detail all the facts, with references, on which my conclusions have been grounded, and I hope in a future work to do this. For I am well aware that scarcely a single point is discussed in this volume on which facts cannot be adduced, often apparently leading to conclusions directly opposite to those at which I have arrived. A fair result can be obtained only by fully stating and balancing the facts and arguments on both sides of each question, and this is here impossible."†

The great modesty which is so strong a characteristic of the man, appears in every line of the history he gives; we cannot fail to see that, had it not been for the interference of Sir Charles Lyell and Dr. Hooker, he would have allowed Mr. Wallace to obtain the credit of that which had cost him twenty-two years of labour, and we believe he would have been capable of rejoicing at the success of his fellow-worker, so utterly devoid does he seem to have been of that spirit of jealous rivalry, which so often mars the works of great men. Darwin, on the contrary, is never grudging of praise to those who have even in the smallest degree forwarded the cause of science, and in the "Historical Sketch of the Progress of Opinion on the Origin of Species" appended to the sixth edition of his work, he gives a full list of all those who have in any degree helped to elucidate the mystery, foremost among whom stands Lamarck; although Darwin shows that, even among the classical writers, some notion of the principle of natural selection existed, and he gives a passage from Aristotle, the concluding part of which reads thus: "Wheresoever therefore, all things together (that is, all the parts of one whole), happened like as if they were made for the sake of something, these were preserved, having been appropriately constituted by an internal spontaneity; and whatever things were not thus constituted

* "Origin of Species." Introduction. † *Ibid.*

perished and still perish." But this, like other passages of somewhat similar import scattered through the writings of the ancient philosophers was probably, as was pointed out in the article on "Epicurus and Lucretius" in the WESTMINSTER REVIEW for April last, "only a single lucky guess out of many false guesses." The case was different with Lamarck, for his conclusions were based upon observation, and although they were in many respects erroneous, Darwin credits him with having been the first who "did the eminent service of arousing attention to the probability of all change in the organic, as well as in the inorganic world, being the result of law, and not of miraculous interposition." Nevertheless, Lamarck had been anticipated by Darwin's grandfather, Dr. Erasmus Darwin, as has been pointed out, not only by his grandson, but by Krause, in the memoir of the elder Darwin, to which Charles Darwin appended a most interesting preliminary notice. Dr. Darwin's "Zoonomia" was published in 1794, and Lamarck's "Philosophie Zoologique" in 1809, upon which Darwin remarks, in a foot-note appended to his "Historical Sketch:" "It is curious how largely my grandfather, Dr. Erasmus Darwin, anticipated the views and erroneous grounds of opinion of Lamarck in his "Zoonomia;" and he adds that which has often been remarked, but of which no reasonable explanation has yet been given: "It is rather a singular instance of the manner in which similar views arise at about the same time, that Goethe in Germany, Dr. Darwin in England, and Geoffroy St. Hilaire in France, came to the same conclusion on the origin of species, in the years 1794-5." We cannot here enter minutely into the differences between the theories of these precursors of Darwin and that propounded by Darwin himself, but the elder Darwin seems to have come so near to the theory afterwards elaborated by his grandson, that we may devote a short space to his views. Krause says of him:—

"He was the first who proposed, and consistently carried out, a well-rounded theory with regard to the development of the living world, a merit which shines forth most brilliantly, when we compare with it the vacillating and confused attempts of Buffon, Linnæus and Goethe. It is the idea of a power working from within the organisms, to improve their natural position, and thus out of the impulses of individual needs to work towards the perfection of Nature as a whole."*

In his "Zoonomia," after pointing out the changes which occur in animals through *cultivation*, as in the case of horses, dogs, pigeons, &c., he goes on to say that similarity of structure shows that they have alike been produced from a similar living filament, adding:—

* "Life of Erasmus Darwin," by Ernest Krause, p. 211.

"From thus meditating on the great similarity of structure of the warm-blooded animals, and, at the same time, of the great changes they undergo both before and after their nativity, and by considering in how minute a portion of time many of the changes of animals have been produced, would it be too bold to imagine, that in the great length of time since the earth began to exist—perhaps millions of ages before the commencement of the history of mankind—would it be too bold to imagine that all warm-blooded animals have arisen from one living filament, which the Great First Cause endued with animality, with the power of acquiring new parts, attended with new propensities, directed by irritations, sensations, volitions and associations, and thus possessing the faculty of continuing to improve by its own inherent activity, and of delivering down those improvements by generation to its posterity, world without end."*

"Cold-blooded animals," he says, "as the fish tribes, bear a great similarity to each other, but differ so much from warm-blooded animals that it may not seem probable, at the first view, that the same living filament could have given origin to this kingdom of animals; yet there are some creatures which unite or partake of both these orders of animation, as the whale and seals; and more particularly the frog, who changes from an aquatic animal furnished with gills to an aerial one furnished with lungs."†

He then goes on to discuss the changes which insects undergo in their progress to maturity, and lastly, includes vegetables among the inferior orders of animals, and concludes thus:—

"Shall we then say that the vegetable living filament was originally different from that of each tribe of animals above described? and that the productive living filament of each of those tribes was different originally from the other? or, as the earth and ocean were probably peopled with vegetable productions long before the existence of animals, and many families of these animals, long before other families of them, shall we conjecture that one and the same kind of living filaments is and has been the cause of all organic life?"

Here we certainly get the theory of evolution: and if we study the works of this eminent man more fully we shall be struck still more by the wonderful insight he had into the origin of things. Krause says truly:—

"In him we find the same indefatigable spirit of research and almost the same biological tendency as in his grandson, and we might, not without justice, assert that the latter has succeeded to an intellectual inheritance, and carried out a programme sketched forth and left behind by his grandfather. Almost every single work of the younger Darwin may be paralleled by at least a chapter in the works of his ancestor; the mysteries of heredity, adaptation, the protective arrangements of animals and plants, sexual selection, insectivorous plants, and

* "Zoonomia," p. 514, *et seq.* † *Ibid.*

the analysis of the emotions and sociological impulses, nay, even the studies on infants, are to be found already discussed in the writings of the elder Darwin."*

What then, it will be said, has caused the grandson to be placed on a pedestal so much higher than that attained by his grandsire? Here again we may quote Krause for an answer:— "It is one thing to establish hypotheses and theories out of the fulness of one's fancy, even when supported by a very considerable knowledge of Nature, and another to demonstrate them by an enormous number of facts, and carry them to such a degree of probability as to satisfy those most capable of judging."† Dr. Erasmus Darwin was well aware of the value and necessity of experiments, for he says, in an apology prefixed to "The Botanic Garden:"—

"It may be proper here to apologize for many of the subsequent conjectures on some articles of natural philosophy, as not being supported by research, investigation, or conclusive experiments. Extravagant theories, however, in those parts of philosophy where our knowledge is yet imperfect, are not without their use; as they encourage the execution of laborious experiments, or the investigation of ingenious deductions, to confirm or refute them. And since natural objects are allied to each other by many affinities, every kind of theoretic distribution of them adds to our knowledge, by developing some of their analogies."‡

In fact, Erasmus Darwin was a theorist, and scarcely more; his theories came wonderfully near to the truth as revealed by his grandson, but they were only guesses, unsupported by those scientific facts which he himself saw to be necessary to their acceptance. Hence, as Krause says: "Dr. Erasmus Darwin could not satisfy his contemporaries with his physio-philosophical ideas; he was a century ahead of them, and was in consequence obliged to put up with seeing people shrug their shoulders when they spoke of his wild and eccentric fancies, and the expression "Darwinising" was accepted in England nearly as the antithesis of sober biological investigations."

Charles Darwin, on the contrary, was eminently practical; he accepted nothing until he had weighed it in the balance of reason and looked at it from every point of view. Every fact, for or against, is brought to bear upon his theories; he takes his readers into his confidence in everything, and tells them *why* he has come to a certain conclusion on a given point. As an example, we may quote a passage from the Introduction to his "Variation

* "Life of Erasmus Darwin," by Ernest Krause, p. 132. Translated by W. S. Dallas.

† *Ibid.* ‡ *Ibid.* p. 135.

of Animals and Plants under Domestication." Speaking of his visit to the Galapagos, and of the general American type of the fauna and flora, varying in each island, whilst these islands yet appeared to be of geologically recent origin, he says:—

"I fancied myself brought near to the very act of creation. I often asked myself how these many peculiar animals and plants had been produced? The simplest answer seemed to be that the inhabitants of the several islands had descended from each other, undergoing modifications in the course of their descent, and that all the inhabitants of the archipelago had descended from those of the nearest land, namely America, whence colonists would naturally have been derived. But it long remained to me an inexplicable problem how the necessary degree of modification could have been effected; and it would have thus remained for ever, had I not studied domestic productions, and thus acquired a just idea of the power of selection. As soon as I had fully realized this idea I saw, on reading Malthus on Population, that natural selection was the inevitable result of the rapid increase of all organic beings; for I was prepared to appreciate the struggle for existence by having long studied the habits of animals."

It is the formulation of this law which Darwin has termed "Natural Selection," but which has perhaps been more felicitously named by Mr. Herbert Spencer "The Survival of the Fittest," a term accepted by Darwin as synonymous, which has given the name of Darwin such wide-spread renown, for this is the pivot upon which all his theories turn. Evolution, as we have seen, was theoretically known to the elder Darwin, to Lamarck, and more obscurely to Buffon, Linnæus and Goethe, but Darwin alone has found the law upon which evolution depends. It is this law only which satisfactorily explains, not alone the advances in the chain of beings, but also that which would otherwise be an inexplicable anomaly, the degradation observable in many forms. On this subject Darwin writes thus:—

"As natural selection acts exclusively through the preservation of profitable modifications of structure, and as the conditions of life in each area generally become more and more complex from the increasing number of different forms which inhabit it, and from most of these forms acquiring a more and more perfect structure, we may confidently believe that, on the whole, organization advances. Nevertheless, a very simple form, fitted for very simple conditions of life, might remain for indefinite ages unaltered or unimproved; for what would it profit an infusorial animalcule, for instance, or an intestinal worm to become highly organized? Members of a high group might even become—and this apparently has occurred—fitted for simpler conditions of life; and in this case natural selection would tend to

simplify or degrade the organization, for complicated mechanism for simple actions would be useless, or even disadvantageous."*

It is difficult to put in a concise form the exact definition of that which commonly goes by the name of Darwinism. It is Evolution based upon Natural Selection, or the Survival of the Fittest; but natural selection is very frequently supplemented by change of environment, by the use and disuse of parts, and by sexual selection, producing variations affecting one sex only which latter is supposed to have been the chief factor in causing the superior strength, and in increasing the effectiveness of offensive weapons among the males of various animals, and the greater amount of ornamentation, especially among birds. Darwin himself defines his theory as—

"the doctrine of Malthus applied to the whole animal and vegetable kingdoms. As many more individuals of each species are born than can possibly survive, and as, consequently, there is a frequently recurring struggle for existence, it follows that any being, if it vary however slightly in any manner profitable to itself, under the complex, and sometimes varying conditions of life, will have a better chance of surviving, and thus be naturally selected. From the strong principle of inheritance any selected variety will tend to propagate its new and modified form."†

In another place he says—

"Let it be borne in mind how infinitely complex and close-fitting are the mutual relations of all organic beings to each other, and to their physical conditions of life, and consequently what infinitely varied diversities of structure might be of use to each being under changing conditions of life. Can it then be thought improbable, seeing that variations useful to man have undoubtedly occurred, that other variations, useful in some way to each being in the great and complex battle of life, should occur in the course of many successive generations? If such do occur, can we doubt—remembering that many more individuals are born than can possibly survive—that individuals having any advantage, however slight, over others, would have the best chance of surviving and of procreating their kind? On the other hand, we may feel sure that any variation in the least degree injurious would be rigidly destroyed. This preservation of favourable individual differences and variations, and the destruction of those which are injurious, I have called Natural Selection, or the Survival of the Fittest. Variations neither useful nor injurious would not be affected by natural selection, and would be left either a fluctuating element, as perhaps we see in certain polymorphic species,

* "Variation of Animals and Plants under Domestication," p. 8. Introduction.

† "Origin of Species," sixth edition. Introduction, p. 3.

or would ultimately become fixed, owing to the nature of the organism and the nature of the conditions."*

Having thus found a law apparently applicable to all life, whether animal or vegetable, Darwin proceeds to test its truth by an extraordinary number of experiments, and by the observations of competent observers everywhere. Domestic animals of course come first under notice, and the extraordinary variations produced in these by human agency are carefully noted and described; the numerous breeds of pigeons, dogs, sheep, pigs, horses and cattle, are commented upon as showing how far variability may be carried, and the same result is traced in cultivated plants. These things are brought forward to prove that there is, both in animals and plants, a natural tendency to vary according to their surrounding, and that, therefore, there is no improbability in their having done so naturally during the many thousands of generations through which all must have passed, and that the accumulated variations in every possible direction, necessary to enable animals and plants to compete successfully with each other in the struggle for existence, have resulted in the innumerable species which now fill the world. These he traces downwards through the long geological ages, till he finds, as he believes, that animals are descended from at most only four or five progenitors, and plants from an equal or lesser number, adding:—

"Analogy would lead me one step farther—namely, to the belief that all animals and plants are descended from some one prototype. But analogy may be a doubtful guide. Nevertheless, all living things have much in common, in their chemical composition, their cellular structure, their laws of growth, and their liability to injurious influences. . . . . With all organic beings, excepting, perhaps, some of the very lowest, sexual reproduction seems to be essentially similar. With all, as far as is at present known, the germinal vesicle is the same; so that all organisms start from a common origin. If we look even to the two main divisions—namely, to the animal and vegetable kingdoms, certain low forms are so far intermediate in character that naturalists have disputed to which kingdom they should be referred. . . . . Therefore, on the principle of natural selection with divergence of character, it does not seem incredible that, from some such low and intermediate form both animals and plants may have been developed; and if we admit this, we must likewise admit that all the organic beings which have ever lived on this earth may be descended from some one primordial form. . . . . No doubt it is possible, as Mr. G. H. Lewes has urged, that at the first commencement of life many different forms were evolved; but, if so, we may conclude that only a very few

* "Origin of Species," sixth edition, chap. iv. p. 63.

have left modified descendants. For, as I have recently remarked in regard to the members of each great kingdom, such as the vertebrata, articulata, &c., we have distinct evidence in their embryological, homologous and rudimentary structures, that within each kingdom all the members are descended from a single progenitor."*

We thus see that Darwin's theories do not include spontaneous generation, which had been accepted theoretically by his grandfather, who wrote in his "Botanic Garden":—

> "Hence without parent, by spontaneous birth
> Rise the first specks of animated earth."

It is evident that spontaneous generation once admitted, would, to a certain extent, interfere with and invalidate Darwin's theory, since by it new forms of life might perpetually arise; and although these might, and would of necessity, belong to the lowest and most simple of organisms, yet their tendency would be to break that continuous chain of being which Darwin would trace from the eozoon to man, unbroken through the long geologic periods to our own days. Hence he says: "As all the living forms of life are the lineal descendants of those which lived long before the Cambrian epoch, we may feel certain, that the ordinary succession by generation has never once been broken, and that no cataclysm has desolated the whole world."†

Darwin, indeed, does not attempt to define or explain the mystery of the *Origin of Life.* He starts with a few simple forms endowed with the vital principle, and with the possibilities of variation, in accordance with their several necessities, and from these he sees arise in a continuous succession, by constant, slight and cumulative modifications, all the forms of life, both animal and vegetable, at present existing or long since extinct upon the globe; and from the past he prophesies the future.

"Judging from the past," he says, "we may safely infer that not one living species will transmit its unaltered likeness to a distant futurity. And of the species now living very few will transmit progeny of any kind to a far distant futurity; for the manner in which all organic beings are grouped, shows that the greater number of species in each genus, and all the species in many genera, have left no descendants, but have become utterly extinct. We can so far take a prophetic glance into futurity as to foretell that it will be the common and widely-spread species, belonging to the larger and dominant groups within each class, which will ultimately prevail, and procreate new and dominant species."‡

We have thus given, as far as possible, Darwin's grand theory

---

* "Origin of Species," sixth edition, chap. xv. p. 425.
† *Ibid.* p. 428. ‡ *Ibid.* p. 428.

of the Origin of Species, a theory accepted in all its fulness by the vast majority of biologists of the present day, but which was at first received with that distrust, ridicule and blind prejudice which are sure to assail new ideas, expecially when those new ideas in any way trench upon opinions long accepted as orthodox. It is not necessary to recall the incredulity with which the discoveries of Galileo, Newton, and other philosophers and discoverers have been received, and it is easy to see that a theory which even more directly attacked the supposed teaching of the Bible would be even more violently opposed; we need not, therefore, be surprised to find page after page of the Catalogue of the British Museum filled with works controverting the theory of Darwin, chiefly from the religious standpoint. To all these attacks the philosopher turned a deaf ear, his adversaries were allowed to air their opinions, and in many instances to show their total ignorance of the doctrine they were in so much haste to refute. Even great naturalists do not appear to have always clearly apprehended the Darwinian theory, as is apparent from a letter which appeared in *Nature* in November, 1880, after the publication of the first part of the *Challenger* reports, wherein Darwin departs from his usual rule of answering not again, and writes:—

"I am sorry to find that Sir Wyville Thomson does not understand the principle of natural selection as explained by Mr. Wallace and myself. If he had done so he could not have written the following sentence: 'The character of the abyssal fauna refuses to give the least support to the theory which refers the evolution of species to extreme variation, guided only by natural selection.' This is a standard of criticism not uncommonly reached by theologians and metaphysicians when they write on scientific subjects, but is something new as coming from a naturalist. Professor Huxley demurs to it in the last number of *Nature;* but he does not touch on the expression of *extreme variation*, nor on that of evolution being guided *only* by natural selection. Can Sir Wyville Thomson name any one who has said that the evolution of species depends only on natural selection? As far as concerns myself, I believe that no one has brought forward so many observations on the effects of the use and disuse of parts as I have done in my 'Variation of Animals and Plants under Domestication;' and these observations were made for this especial object. I have likewise there adduced a considerable body of facts, showing the direct action of external conditions on organisms; though, no doubt, since my book was published much has been learnt on that head. If Sir Wyville Thomson were to visit the yard of a breeder, and saw all his cattle or sheep almost absolutely true—that is, closely similar, he would exclaim: 'Sir, I see here no extreme variation, nor can I find any support to the belief that you have followed the principle of selection in the breeding of your animals.' From what I formerly

saw of breeders, I have no doubt that the man thus rebuked would have smiled, and said not a word. If he had afterwards told the story to other breeders, I greatly fear that they would have used emphatic but irreverent language about naturalists."

But with all Darwin's confidence in the truth of his theory, and its power in producing the observed effects, he does not for a moment ignore the difficulties by which it is surrounded, of some of which he says: they "are so serious that to this day I can hardly reflect on them without being in some degree staggered; but to the best of my judgment, the greater number are only apparent, and those that are real, are not I think fatal to the theory."* These difficulties he classes under four heads:—

First, the absence of so many intermediate forms, which are necessary to the support of the theory.

Secondly, the possibility of one animal having been modified from another of totally different habits and form.

Thirdly, the acquisition of instincts, particularly in insect communities, in which the greater number are sterile, as ants and bees.

Fourthly, the phenomena of hybridism.

We cannot here enter into a discussion of each of these difficulties. The first, which depends upon the imperfection of the geological record, is daily being cleared away by the discovery of the requisite intermediate forms of which we have spoken earlier, and of which Professor Huxley has treated in his lecture on "The Coming of Age of the Origin of Species." The next, which bears upon the transitions of organic beings, is largely treated in the work before us, as well as the gradual acquisition of organs, such as the eye, which is found in all stages of development in different animals; and Darwin adds: "It is a significant fact that even in man, according to the high authority of Virchow, the beautiful crystalline lens is formed in the embryo by an accumulation of epidermic cells, lying in a sack-like fold of the skin; and the vitreous body is formed from embryonic subcutaneous tissue."† Of the third difficulty we treated somewhat largely in an article upon "Ants" in the last issue of the WESTMINSTER REVIEW, and need not now repeat what we there gave as Darwin's views of a most intricate subject.

Hybridism and sterility are dealt with in chapter ix. of the "Origin of Species," but the subject is one upon which there is confessedly much ignorance, and Darwin concludes his summary thus: "Although we are as ignorant of the precise cause of the sterility of first crosses and of hybrids, as we are why animals

* "Origin of Species," sixth edition, chap. vi. p. 133. † *Ibid.* p. 145.

and plants removed from their natural conditions become sterile, yet the facts given in this chapter do not seem to me opposed to the belief that species aboriginally existed as varieties."*

The world in general would probably have forgiven Darwin in time for the unorthodox views expressed in the "Origin of Species," or would have been content to consign him to the tender mercies of theologians as a hopeless heretic, had he not thought it necessary to enlarge upon a subject only lightly touched upon in that work—that is, the "Origin of Man." But at present, nine-tenths of the people who hear the name of Darwin mentioned, exclaim, "Ah, that is the man who says, we are all descended from monkeys, but I don't believe it." In fact, although the "Origin of Species" naturally included in its limits the human race, yet, until the publication of "The Descent of Man" there was a lingering hope that the philosopher would allow man to remain apart—a separate creation, alone endowed with a living soul. That hope was rudely dispelled by the book above named, "The Descent of Man and Selection in Relation to Sex," in which Darwin traces man back to "a hairy quadruped, furnished with a tail and pointed ears, probably arboreal in his habits, and an inhabitant of the Old World." This creature classed among the quadrumana he derives, as well as all the higher mammals, from an—

"ancient marsupial animal; and this, through a long line of diversified forms, either from some reptile-like or some amphibian-like creature; and this, again, from some fish-like animal. In the dim obscurity of the past we can see that the early progenitor of all the vertebrata must have been an aquatic animal, provided with branchiæ, with the two sexes united in the same individual, and with the most important organs of the body—such as the brain and heart—imperfectly developed. This animal seems to have been more like the larvæ of our existing ascidians than any other known form."†

Alas! for human pride. Thus to be traced back to a creature so very low in the scale of being, is humiliating indeed, and we cannot be surprised that henceforth Darwin was looked upon as an arch heretic, an atheist of the deepest dye. That this was anticipated by the author, is shown by the following passage :—

"I am aware that the conclusions arrived at in this work will be denounced by some as highly irreligious; but he who thus denounces them, is bound to show why it is more irreligious to explain the origin of man as a distinct species by descent from some lower form through the laws of variation and natural selection, than to explain

* "Origin of Species," sixth edition, chap. ix. p. 263.
† "Descent of Man," vol. ii. p. 389.

the birth of the individual through the laws of ordinary reproduction. The birth both of the species and of the individual are equally parts of that grand sequence of events, which our minds refuse to accept as the result of blind chance. The understanding revolts at such a conclusion, whether or not we are able to believe that every slight variation of structure, the union of each pair in marriage, the dissemination of each seed, and other such events have all been ordained for some special purpose."*

But, it will be asked, how can Darwin prove such an origin for man as is suggested in the not very flattering and apparently wholly fancy portrait given above? The outward likeness between man and the ape is apparent to everyone, and is still more striking when both are viewed as skeletons; bone for bone they are alike, although there are slight proportional differences, which become more striking when we compare the skulls. How are these differences explained? In the first place, we must remember that Darwin does not trace man's descent from any existing ape, but only believes that both are descended from a common extinct ancestor, the ape retaining more of the parent form than man; but he shows that the rejected appendages, such as tail and pointed ears, exist in a rudimentary, or, perhaps, more correctly, in an aborted state in man, and are more prominent in the embryo than in the adult. In fact, it is to the science of embryology that he turns in support of his theory, proving that the differences between the human embryo in an early stage and that of other mammals are so slight as to be almost imperceptible. The differences observable in the mature form he traces to natural, aided by sexual, selection. To the latter he attributes both the want of hair and its peculiarities of growth in the human race, as well as the varieties of colour and feature in the various races of man; as also the superior strength, both mentally and bodily, of the male.† His argument is, that characters admired by the female, whether bright colours or other ornaments, are acquired by the male, often becoming exaggerated to the detriment of their possessors, because it is the males thus adorned who procreate their kind, and the acquired distinction thus becomes more highly developed with each generation. Hence, it will be seen that sexual selection to a certain extent counteracts natural selection; for whereas the latter acts solely for the good of the species and its preservation, the former sometimes originates characters which

* "Descent of Man," chap. xxi. p. 396.

† It must be observed that, although Darwin's investigations lead him to a belief in the unity of the human race, he does not trace mankind to a single pair, but supposes a tribe of quadrumani to have acquired by slow degrees human characteristics.

tend to endanger their owners, as the bright colours of some animals, the heavy plumes of many male birds, the branching horns of stags, &c. &c.

Of all the human characteristics supposed to have been acquired through sexual selection, the one which appears to us the most difficult to reconcile with Darwin's theory is that of nakedness, because it would seem that some sort of covering would be as necessary to the human or semi-human mammal as to the quadrumana, which are nowhere found divested of hair excepting on the face, and, in some cases, at the posterior portion of the body. With regard to these naked patches, and similar cases in birds, the hair or feathers are supposed to have disappeared through sexual selection, in order that the bright colour of the skin might be displayed; but with man that could hardly have been a sufficient cause, the colour of the skin being always uniform. If, however, we compare the nakedness of man with that of the elephant and rhinoceros, the geological representatives of which in Europe were covered with long hair and wool, we may perhaps surmise that change of habitat may have had something to do with the denudation. We do not at present know where man first made his appearance, but we do know that he hunted the mammoth in Europe, and no earlier traces of him have been found in other continents. If, therefore, he followed the great pachyderms to Africa, the great change of climate may have had some effect in divesting him of his hairy covering, which denudation Darwin says must have taken place at a very early period, and before the several races had diverged from the common stock.* This divergence, as well as all the varieties of form and colour now to be found in the human race, Darwin also ascribes to sexual selection—that is, to the preference of the females for certain slight peculiarities, which in course of time would thus be handed down to their posterity in an exaggerated form.

Another question of far more importance is, how far the superior *mental* powers of man can be traced to evolution acting

* Darwin thinks that man probably originated in Africa. He says:—"In each great region of the world the living mammals are closely related to the extinct species of the same region. It is therefore probable that Africa was formerly inhabited by extinct apes closely allied to the gorilla and chimpanzee; and as these two species are now man's nearest allies, it is somewhat more probable that our early progenitors lived on the African continent than elsewhere. But it is useless to speculate on this subject, for two or three anthropomorphous apes, one the dryopithecus of Lartet, nearly as large as a man, and closely allied to hylobates, existed in Europe during the miocene age; and since so remote a period the earth has certainly undergone many great revolutions, and there has been ample time for migrations on the largest scale.—*Descent of Man*, p. 155.

through natural or sexual selection? Darwin has not been unmindful of the difficulties surrounding this momentous question, respecting which he writes:—

"The greatest difficulty which presents itself, when we are driven to the above conclusion on the origin of man, is the high standard of intellectual power and of moral disposition which he has attained. But every one who admits the general principle of evolution, must see that the mental powers of the higher animals, which are the same in kind with those of mankind, though so different in degree, are capable of advancement. Thus, the interval between the mental powers of one of the higher apes and a fish, or between those of an ant and scale-insect, is immense. The development of these powers in animals does not offer any special difficulty; for with our domesticated animals, the mental faculties are certainly variable, and the variations are inherited. No one doubts that these faculties are of the utmost importance to animals in a state of Nature. Therefore, the conditions are favourable for their development through natural selection. The same conclusion may be extended to man; the intellect must have been all-important to him, even at a very remote period, enabling him to use language, to invent and make weapons, tools, traps, &c.; by which means, in combination with his social habits, he long ago became the most dominant of all living creatures."*

He then proceeds to trace the large size of man's brain as compared with that of the lower animals to the early use of language, and his superior moral qualities to his social instincts, believing these also to have been acquired through natural selection. Upon this subject he remarks:—

"The moral nature of man has reached the highest standard as yet attained, partly through the advancement of the reasoning powers, and consequently of a just public opinion, but especially through the sympathies being rendered more tender and widely diffused through the effects of habit, example, instruction and reflection. It is not improbable that virtuous tendencies may, through long practice, be inherited. With the more civilized races, the conviction of the existence of an all-seeing Deity has had a potent influence on the advancement of morality. Ultimately, man no longer accepts the praise or blame of his fellows as his chief guide, though few escape this influence, but his habitual convictions, controlled by reason, afford him the safest rule. His conscience then becomes his supreme judge and monitor. Nevertheless, the first foundation or origin of the moral sense lies in the social instincts, including sympathy; and these instincts, no doubt, were primarily gained, as in the case of the lower animals, through natural selection."†

It will thus be seen that Darwin looks upon natura selection as capable of producing the most marvellous and diverse effects,

* "Descent of Man," chap. xxi. p. 390. † *Ibid.* p. 394.

not only on the bodily form of organized beings, but also upon their mental and moral faculties. Upon this point there will be many to join issue with him, for even those who might be willing to accept the doctrine of evolution as regards the material form, will demur to it where intellect and morality are concerned. For ourselves, we have always held that the mental faculties of animals differ from those of man in degree only, as we have before pointed out in an article in the WESTMINSTER REVIEW, on "Animal Intelligence." We believe, also, that every unprejudiced observer will find the rudiments of the moral qualities developed in many of the higher animals. Conscience, sympathy, affection, constancy, are certainly not wanting in the dog, and may be found in other animals, as exhibited towards their own kind; and many facts bearing upon this subject have been brought forward by Darwin in his book upon the "Expression of the Emotions." But this interesting and important work we must perforce pass over for the present, with only a bare allusion, in order to glance lightly at his latest publication, "The Formation of Vegetable Mould through the Action of Worms." It has been noticed in the biographical portion of this article that the earliest and latest of Darwin's observations seem to have been largely devoted to these lowly organisms and their work in Nature; and this patient research into objects apparently so insignificant and uninteresting is eminently characteristic of the man. To him nothing was "common and unclean." He saw in all things a fitness for the work assigned to them by Nature, and estimated more correctly than any before him the great work accomplished by minor agents; thus, he calculates that, "In many parts of England a weight of more than ten tons of dry earth annually passes through the bodies of worms and is brought to the surface on each acre of land; so that the whole superficial bed of vegetable mould passes through their bodies in the course of every few years."*

Who but Darwin would have had the patience to make such calculations, to spend years in weighing the castings of worms, studying their habits and discovering their uses, until he is able to prove, that not only is the earth made fertile by the action of these much despised creatures, in constantly bringing fresh earth to the surface, and making it friable, but that they also bear a considerable part in the denudation so constantly going on everywhere; their castings being blown by the wind to lower levels, thus helping to fill up the valleys, and to lower the drainage area to an appreciable extent. He also shows how much they have helped to bury ancient monuments, and to undermine those walls and monuments, the foundations of which

* "Vegetable Mould," chap. vii. p. 385.

are not below their range. As regards the worms themselves, Darwin claims for them a certain amount of reason, for he finds by many minute observations that their actions are not invariable, as would be the case if guided only by instinct, but are changed to suit new surroundings. Thus, leaves which they have not before been familiar with, are treated according to their form, and almost always drawn into their burrows by the narrow end, unless they are required to serve as food, when sometimes they are pulled in by the base; for it must be observed that the plugs of leaves, which we have all seen in worm burrows, serve a twofold purpose—they are used to line the upper part of the burrow to exclude cold and enemies, and they are also stored as food; and it is the admixture of these digested leaves and the earth swallowed by the worms which forms that rich black mould so much esteemed in agriculture. Their intelligence would indeed seem to be considerable, especially when we remember that they can neither see nor hear, although they appear to possess a certain amount of taste, preferring some leaves to others, and can distinguish light from darkness; they are also affected by vibrations, whether produced by striking the ground or by a musical note; they can smell only faintly, but the sense of touch is well developed. It is curious to note here, that Dr. Erasmus Darwin, like his grandson, took considerable interest in worms, and the following extract from the "Zoonomia" will not be without interest:—

"Many of the subterranean insects, as the common worms, seem to retreat so deep into the earth as not to be enlivened or awakened by the difference of our winter days, and stop up their holes with leaves or straws to prevent the frosts from injuring them or the centipes from devouring them. The habits of peace or the stratagems of war of these subterranean nations are covered from our view; but a friend of mine prevailed on a distressed worm to enter the hole of another worm on a bowling-green, and he presently returned much wounded about the head. And I once saw a worm rise hastily out of the earth into the sunshine, and observed a centipes hanging at his tail; the centipes nimbly quitted the tail, and seizing the worm about the middle, cut it in half with its forceps, and preyed upon one part while the other escaped; which evinces they have design in stopping the mouths of their habitation. Go, proud reasoner, and call the worm thy sister!"*

Here, again, as in so many other instances, Darwin appears to have taken up his grandfather's ideas and to have worked them out by patient and elaborate observations into valuable scientific facts; the same may be said with regard to his work on "The Expressions of the Emotions," and those valuable botanical

* "Zoonomia," Erasmus Darwin, section xvi. p. 186.

works, of which we have not room to treat fully. In fact, all Darwin's works read like commentaries upon texts supplied by his grandfather. Erasmus Darwin suggests that plants possess some degree of volition, and Charles Darwin works out the idea into scientific form in his "Habits of Climbing Plants." Erasmus Darwin had noticed the irritability of the *mimosa, dionæ*, &c., and that some plants imprisoned insects which alighted on their leaves. Charles Darwin works out the idea in his book upon "Insectivorous Plants," showing that these actions are analogous to the taking of prey by animals, and serve in like manner to supply them also with food. It is not surprising, when we see the close connection between the crude ideas of the grandsire and the finished work of the grandson, that there should be found some to accuse the latter of having borrowed, without acknowledgment, the ideas of the former. To this accusation, as to all others, Darwin gives the most practical and efficient answer without condescending to notice the charge. In the Biography of Erasmus Darwin, appended as a preface to Krause's work, to which we have before referred, not only does he give to his grandfather the full credit of all the discoveries assigned to him by Krause, but the only grain of bitterness to be found throughout his writings, is expended upon Miss Seward, whom he regards as having, in her "Biography of Erasmus Darwin," wilfully detracted from the fair fame of the man whom she professed to regard as a friend. For his own opponents and detractors he has nothing but courtesy and a silence which is "golden," but the memory of the dead ancestor must be respected and cleared from undeserved reproach.

Before closing this article, which, although long, is altogether too brief for the subject, we must mention two or three more works of the great naturalist which would have sufficed to make him famous had they not been eclipsed by others better known. These are the "Monograph on Cirripedia," published in two volumes by the Ray Society, and full, as usual, of interesting and accurate observations upon creatures little known and less regarded by the world in general; the "Fertilization of Orchids," published in 1862; "Cross and Self-Fertilization," 1875; "Different Forms of Flowers in Plants of the same Species," 1877; and the "Movements of Plants," 1880. The four latter works, all bearing upon botanical subjects, are of great and varied interest, but their consideration must be reserved for future comment.

In his "Variation of Animals and Plants under Domestication," which Darwin looked upon as only the first instalment of that great work of which the "Origin of Species" was but the abstract, he promised in a second work to treat of the "Variation of Organisms in a state of Nature, of the struggle for existence

and the principle of natural selection, discussing the difficulties which are opposed to the theory;" and in a third to "try the principle of natural selection by seeing how far it will give a fair explanation of the several classes of facts alluded to."* We may therefore hope that, in addition to the "Autobiography" which we are led to expect, there may be in store for the world other posthumous works of immense scientific value. Meanwhile, it only remains for the reviewer to sum up the results of those works which have already appeared, and these, perhaps, are best expressed in the words of the address presented to their author by the Yorkshire Naturalists' Union, in November, 1880:—

"One of the most important results of your long-continued labours, and one for which you will be remembered with honour and reverence as long as the human intellect exerts itself in the pursuit of natural knowledge, is the scientific basis you have given to the grand doctrine of evolution. Other naturalists, as you yourself have shown, had endeavoured to unravel the questions that had arisen respecting the origin, classification and distribution of organic beings, and had even obtained faint glimpses of the transformation of specific forms. But it was left to you to show almost to demonstration, the variations which species of plants and animals exhibit, and in natural selection through the struggle for existence, we have causes at once natural, universal and effective, which of themselves are competent not only to explain the existence of the present races of living beings, but also to connect with them and with one another, the long array of extinct forms with which the palæontologist has made us familiar. Further, the Yorkshire naturalists are anxious to place on record their firm conviction that in the care, the patience and the scrupulous conscientiousness with which all your researches have been conducted; in the ingenuity of the experiments you have devised, and in the repeated verifications to which your results have been submitted by your own hands, you have furnished an example of the true method of biological inquiry that succeeding generations will deem it an honour to follow; and that cannot but lead to still further conquests in the domain of organic nature."†

This is, doubtless, the light in which Darwin and his works are regarded by all men of science, in every civilized country throughout the world; and the marvellous change of opinion concerning both, which was manifest at the philosopher's funeral, had been sufficiently marked in 1880, for Professor Huxley, in his lecture on "The Coming of Age of the Origin of Species," to warn his hearers from accepting Darwin's theories, without criticism; for he says:—

"In another twenty years, the new generation educated under the influence of the present day, will be in danger of accepting the main doctrine of the 'Origin of Species' with as little reflection, and it may be with as little justification, as so many of our contemporaries twenty

* "Variation of Animals and Plants," p. 9. † *Nature*, Nov. 1880.

years ago rejected them. Against any such consummation let us all devoutly pray, for the scientific spirit is of more value than its products, and irrationally held truths may be more harmful than reasoned errors."*

That Darwin's views have revolutionized scientific inquiry in every branch of natural history is evident, but even in those sciences upon which he has not himself laboured his influence has been felt, and as his biographer in *Nature* says: "The spirit of Mr. Darwin's teaching may be traced all through the literature of science." Vague theories and speculations have no longer any chance of acceptance, for science requires, thanks to Darwin's teaching, *facts* to support any new idea.

We have thought it advisable in this article to allow the great philosopher to speak for himself as much as possible, convinced that it is only by copious extracts that the true scope and meaning of his immortal works can be understood and appreciated.

How far the theories of Darwin will stand the test of time, it is impossible now to say; they doubtless have in them a considerable amount of truth, and truth which is only confirmed, and strengthened by every fresh discovery in geology, palæontology, botany, zoology and embryology, and therefore we may fearlessly predict that they will never be wholly superseded, but in detail there may be much to learn and unlearn. It may be found that Darwin has laid too much stress upon natural and sexual selection, and especially the latter, and that other forces, at present unknown, have aided and accelerated the process of evolution; but this is what he himself anticipated, for he neither desired nor expected that all his views would be accepted as final. He is constantly using such expressions as "according to my judgment," "as far as we know at present," &c. &c. But of his main theory he entertains, no doubt. He says:—

"Although much remains obscure, and will long remain obscure, I can entertain no doubt, after the most deliberate study and dispassionate judgment of which I am capable, that the view which most naturalists until recently entertained, and which I formerly entertained, namely, that each species has been independently created, is erroneous. I am fully convinced that species are not immutable, but that those belonging to what are called the same genera are lineal descendants of some other and generally extinct species, in the same manner as the acknowledged varieties of any one species are the descendants of that species. Furthermore, I am convinced that natural selection has been the most important, but not the exclusive means of modification."†

Thus far we believe all naturalists, or nearly all, at the present day, are prepared to follow him. And here we might be content to leave the great philosopher until his posthumous works shall

* *Nature*, Nov. 1880. † "Origin of Species," sixth edition, p. 4.

again bring him prominently before the public; but the concluding paragraph of his great work sums up so beautifully, and in so terse a manner, the views of the writer, and gives such an excellent idea of his mental qualifications, that we feel constrained to quote it :—

"It is interesting to contemplate a tangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us. These laws, taken in the largest sense, being growth with reproduction; inheritance which is almost implied by reproduction; variability from the indirect and direct action of the conditions of life, and from use and disuse; a ratio of increase so high as to lead to a struggle for life, and, as a consequence, to natural selection entailing divergence of character, and the extinction of less improved forms. Thus, from the war of Nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms, or into one, and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms, most beautiful and most wonderful, have been, and are being, evolved."*