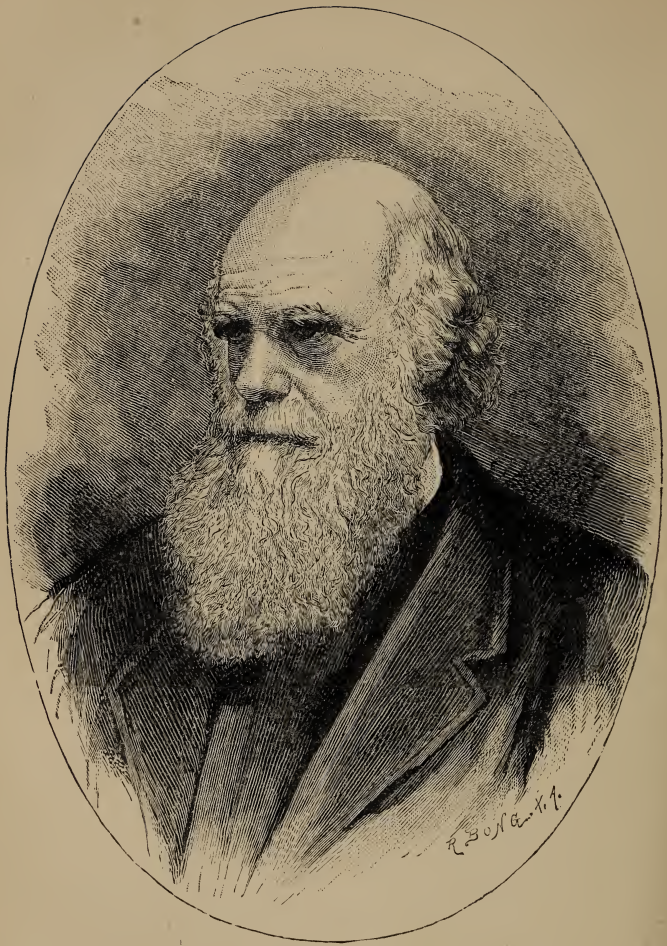

CHARLES DARWIN.
1809–1882

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CHARLES DARWIN, 1809—1882.

THE name which before and above all other names stands conspicuous in the science annals of our age, everybody will admit to be that of Charles Darwin. A writer in the *Allgemeine Zeitung* has called the present century Darwin's century, and from a scientific point of view this is no exaggeration. His fame is due not only to his bold and comprehensive theories which have revolutionized biology, but to the laborious and philosophical spirit in which he conducted his scientific researches; never fitting his facts to his hypotheses, but building up his hypotheses slowly on the foundation of his facts. The important movement initiated by his book 'On the Origin of Species,' published nearly thirty years ago, has so occupied the public mind, has excited so extensive and deep an interest, that 'Darwinism' has become quite a popular topic, as well as the favourite field of controversy, and the battlefield of scientist and theologian. The great argument advanced by Charles Darwin was not entirely novel. The idea of 'descent with modification' had been suggested—in opposition to the old belief that every species of animal or plant owed its existence and present form to a distinct and special creative act—by Buffon (about 1780), Geoffroy St. Hilaire (1795), by Erasmus Darwin and Goethe almost contemporaneously, and, more precisely, by Lamarck (1801-1831), who has some right to be distinguished as the Apostle of Evolution. Darwin's idea was that of 'natural selection,' which he combined with that of 'descent with modification.' Briefly stated, his theory is as follows: Amid the struggle for existence which has been

always going on among living beings, variations of physical conformation and structure, if in any degree profitable to an individual of any species, will tend to the preservation of that individual, and will generally be inherited by its offspring. As a corollary, it is maintained that all the various forms of plant and animal life, past or present, have been evolved by a series of gradual changes in natural descent. The stronger wins the race, or, in one pithy phrase, the Darwinian doctrine means 'the survival of the fittest.'

In his 'Descent of Man, and Selection in Relation to Sex,' Darwin carried his theory of evolution to the farthest issue, maintaining (as expounded by Mr. Grant Allen) that 'the early ancestors of man must have been, more or less, monkey-like animals, belonging to the great anthropoid group, and related to the progenitors of the orang-outang, the chimpanzee, and the gorilla. They must have been once covered with hair, both sexes possessing beards. Their ears were probably pointed and capable of movement, and their bodies were provided with a movable tail. The foot had a great toe somewhat thumb-like in its action, with which they could grasp the branches of trees. They were probably arboreal in their habits, fruit-eaters by choice, and inhabitants of some warm forest-clad land. The males had great canine teeth, with which they fought one another for the possession of the females. At a much earlier period, the internal anatomical peculiarities approached those of the lowest mammals, and the eye was provided with a third eyelid. Peering still farther back into the dim abyss of the ages, Darwin vaguely describes the ancestors of humanity as aquatic animals, allied to the mudfish, for our lungs are known to consist of modified swim-bladders, which must once have served our remote progenitors in the office of a float. The gill-clefts on the neck of the human embryo still point to the spot where the branchiæ once, no doubt, existed. Our primordial birthplace appears to have been a shore washed twice a day by the recurrent tides. The heart then took the shape merely of a simple pulsating vessel; and a long undivided spinal cord usurped the place of the vertebral column. These extremely primitive ancestors of man, thus dimly beheld across the gulf of ages, must have been at least as simply and humbly organized as that very lowest and earliest of existing vertebrates, the worm-like lancelet.'

The most enthusiastic evolutionists contend that all forms of life may be traced back to a fundamental substance which they call protoplasm ; but it is quite possible to accept the principle of evolution, and to part company with these speculative minds before so low a depth is reached. As for Darwin himself, it must be owned that he writes always with infinite modesty, calmness, and sobriety. He never presses his theories with ostentation or exaggeration, but is much more anxious to array before the reader the facts and illustrations which, with a colossal patience, he was never weary of accumulating. The wonderful minuteness of his observations and the extraordinary diligence of his research enabled him to clothe any subject he touched with fresh and novel interest ; and the young reader will find not only instruction but entertainment in this honest-minded and keen-eyed inquirer's 'Movements and Habits of Climbing Plants,' 'Insectivorous Plants,' 'Cross and Self Fertilization,' and in the other works which unfold the results of his lifelong labours.

Necessarily, Mr. Darwin met with numerous opponents. Of these Mr. St. George Mivart was, perhaps, the most formidable, because he adopted the general theory of Evolution while disputing its application to Man, and denying that its cause was to be found in 'natural selection.' Mr. St. George Mivart, in his 'Genesis of Species,' argues that similarity of structure is not always a proof of common origin, and contends with much power, and, I venture to think, with a good deal of success, that man and the ape do not belong to the same ascending or descending series. In his 'Lessons from Nature,' he insists on the fundamental distinctions between man and all other animals ; and with elaborate reasoning points out how and in what degree the human intellect differs from the highest physical operations of beasts.

The novelty of the results wrought out by scientific research and the hazardous speculations in which some men of science indulged, unfortunately induced a conviction among professors of religion that Science was hostile to Christianity, inducing a prolonged and bitter controversy of the most useless character. Gradually it became apparent that the issue on which the two contending parties had joined battle was altogether a false one, inasmuch as it assumed an antagonism which did not really exist. For instance, evolutionists were confounded with atheists, and

it was said that to believe in the descent of man from an ape or an ascidian was to contradict the teaching of revelation. But, obviously, the existence of ape or ascidian presupposed a Creative Power. A celebrated author and divine observed that it was 'just as noble a conception of the Deity to believe that He created a few original forms, capable of self-development into other and needful forms, as to believe that He required a fresh act of creation to supply the voids caused by the action of His laws.' And Darwin himself said, 'I would as soon be descended from that heroic little monkey who braved his dreaded enemy to save the life of his keeper, or from that old baboon who, descending from the mountains, carried away in triumph his young comrade from a crowd of astonished dogs, as from a savage who delights to torture his enemies, offers up bloody sacrifices, practises infanticide without remorse, treats his wives like slaves, knows no decency, and is haunted by the grossest superstition. Man may be excused for feeling some pride at having risen, though not by his own exertions, to the very summit of the organic scale; and the fact of his having thus risen, instead of having been aboriginally placed there, may give him hope for a still higher destiny in the distant future.'

The present writer is one of those who refuse to admit that there is or can be any real discrepancy when the conclusions at which religious teachers arrive on the one side, and men of science on the other, have been definitely fixed. At the same time he freely confesses that so long as the world lasts apparent contradictions must necessarily occur. This is something more than the assertion of the obvious truism that both theologians and men of science are liable to err. The unavoidable and natural result of every fresh discovery of science is a temporary collision between the two forces, because every such discovery challenges a position which previously had been generally accepted. It may not be a position which has any direct support from revelation; but because it has been regarded as final, and because revelation has been interpreted under its influences, any attempt to disturb it provokes jealousy, as though it were—what, perhaps, it is not intended to be—an attack upon religion itself. Theologians, in truth, are always tempted to link indissolubly together revelation and their interpretation of revelation, or religion and prejudice; and then to conclude

that arguments which conflict with the latter are necessarily attacks upon the former. It would be unwise, after all, to complain of this jealousy. Unfortunate, indeed, would it be for the truth if men held it so lightly as to be slow in defence when it is, or seems to be, impugned and controverted; and I refer to it only as affording a natural explanation of the supposed antagonism between Religion and Science.

Nor must it be supposed that only the theologians are at fault. It is not an uncommon thing for scientific enthusiasts to mistake inchoate theories for ascertained conclusions, and thus, without due grounds, to dispute the conclusions of religion. Or, on the other hand, it is not unusual for them to regard the opinions of religious men as identical with the doctrines of revelation, and having, as they think, disproved the one, they too hastily and contemptuously reject the other. I am well aware, indeed, that there are many and brilliant exceptions, and that some of the most illustrious of living men of science see no conflict between the claims of religion and the claims of science, and are not ashamed to own themselves believers in evolution. Still, the rule is, I fear, the other way. With dabblers in science especially, who are naturally more numerous and less cautious than their masters, it is a foregone conclusion that there must be a conflict; and not seldom the best part of their title to be considered scientific men is based upon a pretentious denial of the truths of Christianity. Let the young student prove all things, but hold fast to that which is good. Religion and Science both emanate from the Divine Source of all knowledge; and it is quite certain that so far as each is of God, each must agree with the other. Sooner or later, the apparent discord will be resolved into harmony. 'The secret voice of God to man,' says James Hinton, 'will have in it a revealing of the meaning of the great and earnest toil, especially in science, of the two last centuries.' We know what we know, but not the full significance of what we know. But as nothing in God's world is wasted, so much effort—and such true and patient and laborious effort as Charles Darwin's—will find its crown and consummation at last.

The great-grandfather of Charles Darwin was a Robert Darwin, a gentleman of Nottinghamshire, who seems to have enjoyed some reputation as 'a person of curiosity,' with 'a taste for literature and science.' He was a member of the

Spalding Club, and dabbled a little in antiquarian lore and in geology, as it was then understood. He had five sons, of whom Robert the eldest, and Erasmus the youngest, were authors and botanists. Erasmus attained to some degree of fame as the author of a strange poetical extravaganza or rhymed rhapsody, entitled 'The Botanic Garden,' in which a good deal of cleverness was obscured by its bombastic language. The reader will remember the exquisite ridicule of his style and manner in Canning's 'Loves of the Triangles.' Darwin, however, was a man of very considerable ability, a close observer of nature, and an independent and original thinker; and some of his scientific speculations, such as the origin of species, the fertilization of plants, and the struggle for existence, were afterwards scientifically formulated by his illustrious grandson. In the following lines (from his 'Temple of Nature'), we trace the rudiments of Darwinism:

> 'Organic life beneath the shoreless waves
> Was born, and nursed in Ocean's pearly caves;
> First forms minute, unseen by spheric glass,
> Move on the mud, or pierce the watery mass;
> Then, as successive generations bloom,
> New powers acquire, and larger limbs assume;
> Wherever countless groups of vegetation spring,
> And breathing realms of fin and feet and wing.'

By his first wife, Mary, daughter of Mr. Charles Howard, Dr. Erasmus Darwin had a son, named Robert Waring Darwin, who entered the medical profession, became a physician at Shrewsbury, a Fellow of the Royal Society, and had all the family partiality for natural history studies. He married Susannah Wedgwood, daughter of Josiah Wedgwood, the famous potter, and a man of genius in his way—and their son was Charles Robert Darwin, who has made the family name immortal.

Charles Robert Darwin was born at The Mount, Shrewsbury, on the 12th of February, 1809. His mother was even then in declining health, and when he was between eight and nine she died. Young as he was, he appears to have derived some benefit from her teaching; for one of his schoolfellows remembers him plucking a plant, and recalling one of her elementary lessons in botany; but in later life his recollection of her was very indistinct. Besides Charles, the family

consisted of an elder son, Erasmus, who died in 1881, and four daughters, of whom these pages can take no notice. Charles was sent to a private school in Shrewsbury in the spring of 1817. In the Midsummer of 1818 he was removed to the Shrewsbury Grammar School, then under the rule of Dr. Butler. Darwin, in after-life, looked back upon much of the time he had spent there as wasted; and although the school was distinguished for its 'classics,' used to say that the only bit of real education he got there was Euclid, done as an extra subject.

Charles gained scant distinction at Shrewsbury Grammar School. He had no inclination for the dead languages, and he took little part in the school games, preferring long solitary rambles, and silent reveries, and the collection of shells, seals, coins, minerals, and other articles. He was removed to Edinburgh University in 1825, where he first turned his attention to the studies which became afterwards the pleasure and occupation of his well-spent life. There he joined the Plinian Society, and made his essay as a scientific writer in a paper on the Ova of the Flustra* (March 27th, 1827), in which, he said, he had discovered organs of motion—the first result of his remarkable faculty of minute investigation. But he did not do much good at Edinburgh, and he evinced neither a talent nor an inclination for the medical profession, which his father had wished him to take up. Accordingly he was sent to Cambridge, where, early in 1828, he was entered at Christ's College. He had the good fortune here to become acquainted with Professor Henslow, the well-known botanist, who took a special interest in his intellectual development, and encouraged his bias towards natural science. In later life Darwin gratefully recorded his extensive obligations towards him:

'Once every week he kept open-house in the country, and all who cared for natural history attended these parties. When only a few were present, I have listened to the great men of those days, conversing on all sorts of subjects, with the most varied and brilliant powers. This was no small advantage to some of the younger men, as it stimulated their mental activity and ambition. Two or three times in each session he took excursions with his botanical class; either a long way to the habitat of some rare plant, or in a barge down the river to the

* That is, the floating eggs of the common sea-mat.

fens, or in coaches to some more distant place, as to Gamtingay, to see the wild lily of the valley and to catch on the heath the rare natter-jack. These excursions have left a delightful impression on my mind. He was, on such occasions, in as good spirits as a boy, and laughed as heartily as a boy at the misadventures of those who chased the splendid swallow-tail butterflies across the broken and treacherous fens. He used to pause every now and then, and lecture on some plant or other object; and something he could tell us on every insect, shell, or fossil collected; for he had attended to every branch of natural history. . . . As time passed on at Cambridge, I became very intimate with Professor Henslow, and his kindness was unbounded; he continually asked me to his house, and allowed me to accompany him in his walks. He talked on all subjects, including his deep sense of religion. I owe more than I can express to this excellent man. . . . During the years when I associated so much with him, I never once saw his temper even ruffled. He never took an ill-natured view of anyone's character, though very far from blind to the foibles of others. It always struck me that his mind could not be even touched by any paltry feeling of vanity, envy, or jealousy. With all this equality of temper and remarkable benevolence, there was no insipidity of character. A man must have been blind not to have perceived that, beneath this placid exterior, there was a vigorous and determined will. When principle came into play, no power on earth could have turned him one hair's breadth. . . . In intellect, as far as I could judge, accurate powers of observation, sound sense, and cautious judgment seemed predominant. Nothing seemed to give him so much enjoyment as drawing conclusions from minute observations. Reflecting over his character with gratitude and reverence, his moral attributes rise, as they should do in the highest character, in pre-eminence over his intellect.'

In describing Henslow's character, Darwin shadowed out his own. He had the same modesty, the same sincerity, the same elevation of mind, the same kindliness of heart. Intellectually, he was vastly his superior; but here, too, there was a certain harmony between master and pupil: both had the same strong love of truth, both the same clear and rich judgment, both the same faculty of patient and enlightened observation. Darwin was, in fact, a greater Henslow, with a wider range of view, a

profounder insight, and a more various knowledge, but in essential respects bearing a wonderfully close resemblance.

Darwin took his B.A. degree in 1831, and his M.A. degree in 1837. In the latter year his work in life was unexpectedly placed before him; and he began his illustrious career as a scientific discoverer. The Government had determined on despatching H.M.S. *Beagle* on a surveying expedition,* under the command of Captain Fitzroy, who immediately looked about for a young naturalist to accompany him as his guest. Professor Henslow recommended Darwin, and Darwin accepted the offer, on condition that he might be at liberty to leave the *Beagle* and retire from the expedition, and that he should pay a fair share of the expenses of the captain's table.

The voyage, which proved very memorable in the annals of science, lasted nearly five years, and afforded Darwin abundant opportunities for prosecuting zoological, botanical, and geological researches. The countries visited happened to be just those which were best adapted for developing his latent powers and suggesting to his mind those subtle problems of life and its origin, creation and its mysteries, which he afterwards attempted to solve with so much skill and patience. 'The Cape de Verdes, and the other Atlantic islands, with their scanty population of plants and animals, composed for the most part of waifs and strays drifted to their barren rocks by ocean currents, or blown out helplessly to sea by heavy winds; Brazil, with its marvellous contrasting wealth of tropical luxuriance and self-strangling fertility—a new province of interminable delights to the soul of the enthusiastic young collector; the South American pampas, with their colossal remains of extinct animals, huge geological precursors of the stunted modern sloths and armadilloes that still inhabit the self-same plains; Tierra del Fuego, with its almost Arctic climate, and its glimpses into the secrets of the most degraded savage types; the vast range of the Andes and the Cordilleras, with their volcanic energy and their closely crowded horizontal belts of climatic life; the South Sea Islands, those paradises of the Pacific, Hesperian fables true, alike for the lover of the picturesque and the biological student; Australia, that surviving fragment of an extinct world, with an antiquated fauna, whose archaic character still closely recalls

* To survey the coasts of Chili, Peru, Patagonia, and Tierra del Fuego, and carry a chain of chronometrical measurements round the world.

the European life of ten million years back in the secondary epoch—all these, and many others equally novel and equally instructive, passed in long alternating panorama before Darwin's eyes, and left their images deeply photographed for ever after on the lasting tablets of his retentive memory. That was the real great university in which he studied nature and read for his degree. Our evolutionist was now being educated.'

The interesting story of his experiences Mr. Darwin told in his 'Journal of Researches into the Geology and Natural History of the Various Countries visited by H.M.S. *Beagle*,' now better known by the more descriptive and compact title of 'A Naturalist's Voyage round the World.' It was published in 1839; and the scientific world at once perceived that a new star of surpassing brilliancy had risen above the horizon. The reader of the 'Journal' could not but be impressed by the author's scrupulous fairness, his minute accuracy of statement, his careful research, his power of generalization, and his clearness of expression. We cannot follow him through the long record of his adventures and discoveries, but we must give the young reader some idea of the varied interest of the book in order to justify our praises of it. The account of the Galapagos Archipelago, that curious cluster of islands off the west coast of South America, is characterized by its freshness. 'It was most striking,' he says, 'to be surrounded by new birds, new reptiles, new shells, new insects, new plants, and yet by innumerable trifling details of structure, and even by the tones of voice and plumage of the birds, to have the temperate plains of Patagonia, or the hot, dry deserts of Northern Chili, vividly brought before my eyes. Why, on these small points of land, which within a late geological period must have been covered by the ocean, which are formed of basaltic lava, and therefore differ in geological character from the American continent, and which are placed under a peculiar climate—why were their aboriginal inhabitants, associated, I may add, in different proportions both in kind and number from those on the continent, and therefore acting on each other in a different manner—why were they created on American types of organization? It is probable that the islands of the Cape de Verd group resemble, in all their physical conditions, far more closely the Galapagos Islands than those latter physically resemble the coast of America, yet the aboriginal inhabitants of the two groups are totally unlike;

those of the Cape de Verd Islands bearing the impress of Africa, as the inhabitants of the Galapagos Archipelago are stamped with that of America.'

Darwin was much struck by the extraordinary tameness of the birds. He pushed a hawk from the branch of a tree with the muzzle of his gun. On a pitcher which he was holding in his hand a mocking-thrush perched, and proceeded with great composure to sip out of it. He saw a boy, in want of his dinner, kill, with a switch, a number of doves and finches which had come to a well to drink. Commenting on the exceeding tameness of birds in other parts of the world little frequented by man, he observes that there is no way of accounting for their fear of man except as an inherited habit. 'Comparatively few young birds, in any one year, have been injured by man in England, yet almost all, even nestlings, are afraid of him; many individuals, on the other hand, both at Galapagos and at the Falklands, have been pursued and injured by man, but yet have not learned a salutary dread of him. We may infer from these facts what havoc the introduction of any new beast of prey must cause in a country, before the instincts of the indigenous inhabitants have become adapted to the stranger's craft or power.'

In connection with his visit to Tahiti, Darwin does ample justice to the good work done by Christian Missions, which some would-be witty writers have, in recent books of travel, done their best to impugn and depreciate. 'There are many,' he says, 'who attack, even more acrimoniously than Kotzebue, the missionaries, their system, and the effects produced by it. Such reasoners never compare the present state with that of the island only twenty years ago, nor even with that of Europe at this day; but they compare it with the high standard of Gospel perfection. They expect the missionaries to effect that which the Apostles themselves failed to do. Inasmuch as the condition of the people falls short of this high standard, blame is attached to the missionary, instead of credit for that which he has effected. They forget, or will not remember, that human sacrifices, and the power of an idolatrous priesthood; a system of profligacy unparalleled in any other part of the world; infanticide a consequence of that system; bloody wars, where the conquerors spared neither women nor children—that all these have been abolished; and that dishonesty, intemperance, and

licentiousness have been greatly reduced by the introduction of Christianity. In a voyager to forget these things is base ingratitude; for should he chance to be at the point of shipwreck on some unknown coast, he will most devoutly pray that the lesson of the missionary may have extended thus far.'

Our naturalist also visited New Zealand and Australia, and afterwards the Keeling Islands, where he studied the coral-formation, and constructed the first satisfactory system in explanation of the atolls or lagoon islands, which stud the surface of the Pacific. Various explanations had previously been attempted, but all had failed to fit in with the facts. Mr. Darwin showed that the oceanic islands round which the coral animals build their reefs gradually subside; and as they subside, the reefs are carried up higher and higher until they rise above the level of the water, when, the island having disappeared, they enclose with a white and glittering ring a shining patch of bright-emerald sea. Some of these atolls are from one hundred to one hundred and fifty miles in circumference; and Mr. Darwin remarks that 'the immensity of the ocean, the fury of the breakers, contrasted with the lowness of the land, and the bright green water within the lagoon, can hardly be imagined without having been seen.'

The vast materials which Darwin had collected and brought home underwent an extensive process of classification and description, with very precious results to science, under Darwin's editorship. Sir Richard Owen undertook the fossil Mammals; Mr. Waterhouse, the living Mammals; Mr. Gould discussed the Birds; the Rev. I. Jenyns, the Fish; and Mr. Bell, the Reptiles and Amphibians. The Insects which he had collected were described by Mr. Waterhouse and others; the Plants by Mr. Hooker; Professor Henslow cataloguized the Plants from the Keeling Islands; and Mr. Berkeley commented on the Cryptogamic Plants.

The geological researches of our great observer had still to be put in a concrete form before the scientific world; and in 1842 he published his fascinating book on the 'Structure and Distribution of Coral Reefs,' which was followed, in 1844, by his 'Geological Observations on the Volcanic Islands visited during the Voyage of H.M.S. *Beagle;*' and in 1846 by 'Geological Observations on South America.' The theory of atoll-formation to which I have referred was elaborated in the

first of these volumes with a completeness and a minuteness which fairly conquered the preconceived opinions of men of science. As Dr. Geikie says: 'Its simplicity and grandeur strikes every reader with astonishment. It is pleasant, after the lapse of many years, to recall the delight with which one first read the "Coral Reefs;" how one watched the parts being marshalled into their places, nothing being ignored or passed lightly over; and how, step by step, one was led up to the grand conclusion of wide oceanic subsidences. No more admirable example of scientific method was ever given to the world; and even if he had written nothing else, this treatise alone would have placed Darwin in the very front of investigators of Nature.'

As a slight recognition of his surpassing services, Darwin was elected a Fellow of the Royal Society. He was also appointed Secretary to the Geological Society; but the duties of the post occupied too much of his time, and he retired from it in 1841, that he might thenceforward devote himself entirely to science. It was before this Society that he read a short paper on the 'Formation of Mould.' Forty-four years later he gave to the world the result of his prolonged investigations into this subject. It is characteristic of the patience as well as the honesty of the man who would deduce no conclusions except from a wide sweep of consistent facts, that he pursued for so long a period his inquiries and experiments. In December, 1842, a quantity of broken chalk was distributed over part of a field at Down, in order to test the action of earthworms; and after an interval of twenty-nine years in November, 1871, a trench was dug to ascertain the results. How few naturalists have ever waited so long and so patiently to discover the outcome of a solitary experiment! Who does not see that it was to this faculty of patient work and conscientious inquiry that Darwin owed his success?

The reference to Down reminds us that Darwin, early in 1839, was married to his cousin, Miss Emma Wedgwood, daughter of Josiah Wedgwood, of Maer Hall, and that in 1842 he settled at Down House, near Orpington, in Kent, where he spent the remainder of his happy and honoured life among his conservatories and gardens, his fowls and pigeons, with his children growing up beside him in an atmosphere of love and light, and his mind constantly occupied in scientific analysis and research. The sole shadow upon it was that which

originated in his almost continuous ill-health, for it sometimes proved an interruption to his work. Otherwise, his days were methodically arranged so as to permit of sufficient study and recreation. He rose very early, and was frequently in his library at eight, after having breakfasted and taken his first morning walk. Later in the day he went for a second walk, often in his own grounds, but sometimes wandering among the green fields and leafy lanes to a considerable distance. He was wont to vary the walks by quiet rides on a favourite black cob; but the cob falling and dying by the roadside, he gave up his habit of riding. Part of the evening was given up to his books; part to the company of his family and friends, and of the eminent guests whom his world-wide fame attracted to the quiet Kentish village. Sometimes Mrs. Darwin or a friend read aloud for the amusement of the little circle, light literature being generally chosen as a relief to the great naturalist's severe and serious studies.

The great French botanist, De Candolle, furnishes a delightful sketch of Darwin at home:

'It was on a beautiful autumn morning,' he says, 'in 1880, that I arrived at the Orpington station, where my illustrious friend had a brake waiting for me. The drive to Down takes an hour. It presents nothing remarkable, unless it be the residence,* surrounded by beautiful trees, of Sir John Lubbock. I will not here speak of the kind reception that was given me at Down, or of the pleasure which I felt in chatting familiarly with Mr. and Mrs. Darwin and their son Francis. I will only remark that Darwin at seventy was more animated and seemed happier than when I had seen him forty-one years before. His eye was bright, and his expression cheerful; his conversation varied, free, and pleasing; his English easy for a foreigner to understand. Around the house there were no signs of his researches. Darwin used simple means. I looked for the greenhouse, in which those beautiful researches on vegetable hybrids had been made: it contained nothing but a vine. One thing struck me, although it was nothing uncommon in England, where animals are petted. A heifer and a colt were feeding close to us, with a familiarity which told of kind masters, and I heard the joyful barking of dogs. "Here," said I, "the history of the variations of animals has been written; and, no

* High Elms.

doubt, the observations are still carried on, for Darwin is never idle." I did not expect that the earthworms—those meanest of animals, over whose habitations I was walking, were to be the subject of a new memoir, in which Darwin was to show once more what great effects may spring from small causes often repeated. He had been busy with them thirty years, had I but known it. On our return to the house, Darwin showed me his study—a large room, lighted on both sides, with one table for writing and another for experimental apparatus. An experiment on the movements of stems and roots was then in progress. I should have liked to see the register of experiments, but the hours slipped away like minutes.'

The events of Darwin's life were the successive publications of his great works, each of which marked a stage in the development of natural science, and advanced us nearer to a knowledge of the principles of creation. No great revolution, moral, political, or scientific, is achieved by a single mind. It is the one mind that shapes and gathers up the results, combines the scattered ideas of various thinkers into a harmonious whole. But others have been at work before him, laying down the foundation on which is raised the complex structure of his system, or educating the world to receive it by the seed which has dropped hap-hazard from their uncertain hands. It was so with Darwinism. The great naturalist had had his predecessors, whose theories, speculations, or conjectures had in some wise prepared the way before him. We have already spoken of Erasmus Darwin and Lamarck; but Dr. Wells, Herbert Spencer, and Patrick Matthew, among others, had formed some vague conception of the law of natural selection. And Mr. Alfred Wallace, the eminent historian of the Malay Archipelago, had actually arrived at the same conclusion as Darwin almost at the same time. But it was the distinguishing work of Darwin that he recognised the universal, where Wells and Spencer had seen only the particular; that he built up a vast and irresistible inductive system, where Matthew and Wallace had but thrown out a pregnant hint of wonderful *à priori* interest and suggestiveness. It is one thing to conceive the idea of a campaign; it is quite another thing to carry it to a victorious issue. Talent may define and draw out a ground-plan; but it is genius alone that can raise to the skies the lofty column or the august temple.

In 1858 Mr. Wallace, who was then exploring the Malay Archipelago, sent to Mr. Darwin a memoir to be submitted to the Linnæan Society, from which it appeared that he had arrived at almost exactly the same conclusions as Mr. Darwin himself on the Origin of Species. Sir Charles Lyell and Dr. Hooker, who were both acquainted with Mr. Darwin's work, thought it advisable, in justice to himself, that along with Mr. Wallace's paper should be published some extracts from his own manuscript. On the 1st of July, 1858, both contributions were read before the Linnæan Society; and on the 24th of November in the following year was published 'The Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life.' It is impossible to exaggerate the sensation it produced. The originality and boldness of its doctrines startled commonplace minds, which ever suppose that whatever is new cannot be true; while theologians, too hastily concluding that nothing can be orthodox which is not directly mentioned in Genesis, raised a hue-and-cry against its 'atheistical speculations.' The two great Quarterly Reviews brought their artillery to bear on the unfortunate philosopher; a thousand pulpits launched at him the thunderbolts of religious conviction; the wits assailed him with the blunt arrows of unintelligent ridicule; Lord Beaconsfield (then Mr. Disraeli) formulated the unworthy sneer that *he* was 'on the side of the angels.' But the principal leaders of scientific thought became his avowed champions, or at all events gave him a modified support. Gradually the irresistible force of his facts and his arguments compelled attention and secured assent. Orthodoxy recovered from its needless alarm, when it was seen that nothing in the theory of Evolution necessarily did away with the motive action in the first place of an Infinite and Almighty Creator; and men of the profoundest religious faith openly proclaimed their adherence to the new teaching. *Magna est veritas, et prævalebit.* Darwinism stood erect in defiance of the storm that had raged around it, because it was built upon a foundation of truth; because its grand generalizations were not the figments of a fertile imagination, but the logical deductions from carefully ascertained facts.

It is unnecessary for us here to attempt an exposition of a book which is so widely known; nor, indeed, would it be

possible for us in our limited space to present anything like a fair and intelligible summary of its arguments. These are so closely interlinked that they must be taken as a whole, or their absolute conclusiveness cannot properly be appreciated. Let not the young student suppose that the 'Origin of Species,' because it wears a scientific character, is dull and heavy reading. The charm of its narrative is so great that the reader is carried along from page to page with scarcely an effort; and the style is so easy, and the explanations are so clear, that even the unscientific will find little difficulty in understanding it. We shall limit ourselves, therefore, to a single specimen of the interesting illustrative facts which its author has brought together; and we shall take the remarkable adaptation of one of the orchidaceous plants to the purpose of fertilization.

'This orchid (the Cryanthos) has part of its labellum or lower lip hollowed out into a great bucket, into which drops of almost pure water continually fall from two secreting horns which stand above it; and when the bucket is half-full, the water overflows by a spout on one side. The basal part of the labellum stands over the bucket, and is itself hollowed out into a sort of chamber with two lateral entrances; within this chamber there are curious fleshy ridges. The most ingenious man, if he had not witnessed what takes place, would never have imagined what purpose all those parts serve. But Dr. Crüger saw crowds of large humble-bees visiting the gigantic flowers of this orchid, not in order to suck nectar, but to gnaw off the ridges within the chamber above the bucket, and their wings being thus wetted they could not fly away, but were compelled to crawl out through the passage formed by the spout or overflow. Dr. Crüger saw a "continual procession" of bees thus crawling out of their involuntary bath. The passage is narrow, and is roofed over by the column, so that a bee, in forcing its way out, first rubs its back against the viscid stigma, and then against the viscid glands of the pollen-masses. The pollen-masses are thus glued to the back of the bee which first happens to crawl out through the passage of a lately expanded flower, and are thus carried away. Dr. Crüger sent me a flower in spirits of wine, with a bee which he had killed before it had quite crawled out, with a pollen-mass still fastened to its back. When the bee, thus provided, flies to another flower, or to the same flower a second time, and is pushed by its com-

rades into the bucket and then crawls out by the passage, the pollen-mass necessarily comes first into contact with the viscid stigma, and adheres to it, and the flower is fertilized. Now at last we see the full use of every part of the flower: of the water-secreting horns, of the bucket half full of water, which prevents the bees from flying away, and forces them to crawl out through the spout, and rub against the properly placed viscid pollen-masses and the viscid stigma.'

Darwin's great principle is that of 'natural selection' or 'survival of the fittest.'* That is, the world being over-populated, a constant struggle is going on between the different species and the different members of the same species for existence; and in this struggle the weakest, or the least fit, necessarily suffer, and are gradually swept away. Animals and plants increase faster than their means of subsistence, and are, therefore, perpetually battling for their food-supply, whether this be flesh, or grain, or vegetables, as in the first case; or carbonic acid, water, or sunshine, as in the second. It is true that the lion eats the antelope, and there is then a struggle between different species; but a fiercer struggle is that between lion and lion, or between two members of the same species. A thousand seedlings occupy the space where, ultimately, only a few can live; between these seedlings a desperate warfare is carried on, in which the strongest and best adapted are victorious. Owing to this state of things, variations—however slight in themselves, and in whatsoever cause originating, if in any degree advantageous to the individual or species presenting them—will tend to the preservation of the particular organism, and, being generally inherited by its offspring, will similarly tend to increase and multiply in the world at large.

For example: In the desert, with its monotonous sandy colouring, a black insect or a white, still more certainly a red or blue insect, would be immediately detected and promptly devoured by its natural enemies—the birds and lizards. But greyish or yellowish insects would probably fail to be discovered at first sight, and would escape so long as any more conspicuous individuals of their own kind existed, for the birds and lizards to consume at their leisure. Hence it would not be long before the desert would be stripped of all but the greyish and yellowish insects; and even among these,

* 'Survival of the fittest' is Mr. Herbert Spencer's phrase.

the birds would naturally pounce upon those which differed most in colour from the sand around them. Those which chanced to vary most in the direction of a sandy or spotty colour would be the likeliest to survive and to become the parents of future congregations. Thus, in the course of ages, all desert-inhabiting species have become sand-coloured, because the more conspicuous were constantly destroyed by their vigilant foes, while the least conspicuous escaped and were enabled to fulfil the duty of reproduction.

In concluding his great work, Mr. Darwin says :

'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 to 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 highest 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.'

In further illustration of the system he had propounded, Mr. Darwin published, in 1862, his very interesting and attractive book on Orchids: 'On the Various Contrivances by which Orchids are Fertilized by Insects.'* Then, in 1865, came the

* This is, to us, one of the most fascinating of Mr. Darwin's books, opening a magic portal into the enchanted region of science. The reader who turns to its charming pages will be astonished by the immense number of ingenious devices by which Natural Selection has provided for the safe transference of the fecundating pollen from stamens to stigmas within the

'Movements and Habits of Climbing Plants;' and, in 1868, a wonderful collection of facts, gathered from all parts of the world, and marshalled in order with wonderful patience and ability, the 'Variation of Animals and Plants under Domestication.'

In 1871 the storms of controversy were again aroused by Mr. Darwin's second *magnum opus*, 'The Descent of Man and Selection in Relation to Sex;' but they subsided much more quickly than those which had been provoked by the 'Origin of Species.' Friends and opponents alike could shake hands over his next essay, 'The Expression of the Emotions in Man and Animals,' which has a special interest and attraction, not only on account of its philosophical theories, but also on account of its valuable accumulation of facts. As regards the former, it may be remembered that Sir Charles Bell, in his Bridgewater treatise, maintains that man was endued with sundry small facial muscles for no other purpose than to express his emotions. Darwin, on the contrary, lays down three principles for consideration: first, the principle of serviceable associated habits; second, the principle of antithesis; and third, the principle of actions due to the constitution of the nervous system, independently from the force of the will, and independently to a certain extent of habit. He proceeds to show that the first of these principles leads to the performance of actions expressive of emotions, because certain everyday actions are of direct or indirect service under certain states of mind, in order to relieve or gratify certain sensations, desires, etc.; and whenever the same state of mind is induced, there is a strong and involuntary tendency to the performance of movements of a directly opposite nature, though these are of no use; and such movements are in some

limits of a single group of plants. Sometimes the fertilizing material adheres automatically between the eyes of the exploring bee, and by the drying of its stalk is bent round so as to come in contact with the surface of the stigma. In other cases, the pollen club is elastically projected by a sensitive fibre, and actually flung by its sensitive antennæ at the unconscious head of the fertilizing insect. Again, the flower-lip secretes a moisture which wets the bees' wings, and compels them to creep out of the chalice by a passage close to the anthers and stigma. Or the honey lies at the bottom of so long a tube that only the fertilizing moth, with a proboscis ten or twelve inches long, can penetrate into the deep recess where the treasured sweets are secreted.

cases highly expressive. And the third principle occurs because, when the sensorium is powerfully excited, nerve-force is generated in excess, and is transmitted in certain definite directions depending on the connection of the nerve-cells, and partly on habit. It is needless to say that these principles are substantiated and elucidated by illustrations of a positive character.

It is difficult to place before the young reader any finer example of a well-spent life—a life devoted to the service of truth and the extension of human knowledge—than that of Charles Darwin. Though endowed with ample pecuniary means, and at liberty to enjoy a refined and even luxurious leisure, he devoted himself, with indefatigable energy and inexhaustible patience, to the accumulation of facts and the elucidation of great principles. His industry never laxed. In 1875 he published his 'Insectivorous Plants;' in 1876, the 'Effects of Cross and Self Fertilization in the Vegetable Kingdom;' and in 1877, the 'Different Forms of Flowers and Plants of the Same Species.' It has been well said that those three books—which exhibit his characteristic attention to detail and his usual lucidity of statement, revolutionized the science of botany.

What he did in this direction has been estimated by a singularly competent authority, Mr. Thiselton Dyer, who says:

'Notwithstanding the extent and variety of his botanical work, Mr. Darwin always disclaimed any right to be regarded as a profound botanist. He turned his attention to plants, doubtless because they were convenient objects for studying organic phenomena in their least complicated forms; and this point of view, which, if one may use the expression without disrespect, had something of the amateur about it, was in itself of the greatest importance. For, from not being, till he took up any point, familiar with the literature bearing on it, his mind was absolutely free from any prepossession. He was never afraid of his facts, or of forming any hypothesis, however startling, which seemed to explain them. However much might be attributed to inheritance as a factor in organic phenomena, tradition went for nothing in studying them. In anyone else such an attitude would have produced much work that was crude and rash. But Mr. Darwin, if one may venture on language which will strike no one who had conversed with him as overstrained, seemed by gentle persuasion to have penetrated that

reserve of nature which baffles smaller men. In other words, his long experience had given him a kind of instinctive insight into the method of attack of any biological problem, however unfamiliar to him, while he rigidly controlled the fertility of his mind in hypothetical explanations by the no less fertility of ingeniously devised experiment. Whatever he touched, he was sure to draw from it something that it had never before yielded, and he was wholly free from that familiarity which comes to the profound student in every branch of science, and blinds the mental eye to the significance of things which are overlooked because always in view.'

In 1880 Mr. Darwin published his 'Power of Movement in Plants,' in which he was assisted by his son, Mr. Francis Darwin; while he received some help from his sons William and Horace in his last and perhaps most generally popular work, 'The Formation of Vegetable Mould through the Action of Worms, with Observations on their Habits,' published in 1881. This book on earthworms is of interesting quality, even for the non-scientific reader; the greater portion of its details being new and fresh. It teaches us that worms cannot hear, but to some extent are sensible of light and heat; that their olfactory organs are very feeble, but that they show a decided preference for certain kinds of food over others. Thus they prefer the leaves of the wild cherry and carrots to those of cabbages and turnips; they are fond of horse-radish leaves, but fonder still of those of onions. No one will doubt that they are endowed with some slight measure of intelligence who has seen the ingenuity they exercise in drawing various objects into their burrows, which are not mere excavations, but may rather be described as tunnels lined with cement. The extent to which their labours affect the surface of the globe is perfectly amazing; and the agriculturist is, perhaps, little aware of the fact that they are among his best and most indefatigable helpers. In many parts of England their labours are on so large a scale that on a single acre two tons of earth will pass through their bodies. The experiments at Down, to which we have already referred, show that the mould was thrown up at the rate of 22 inches in a hundred years. In December, 1842, part of a field near Down House was covered with broken chalk, and in November, 1871, when a trench was dug, a line of white nodules could be traced, 7

inches below the surface. Another field, known as 'The Stony Field,' was converted into pasture in 1841, and Mr. Darwin wondered whether he should live to see the larger flints covered; but, in 1871, a horse could gallop over the solid turf from end to end, and not strike a single stone with his hoof.

'Archæologists are not aware,' says Darwin, 'how much they owe to worms for the preservation of many ancient objects. Coins, gold ornaments, stone implements, etc., if dropped on the surface of the ground, will infallibly be buried by the castings of worms in a few years, and will thus be safely preserved until the land at some future time is turned up. For instance, many years ago a grass field was ploughed on the northern side of the Severn, not far from Shrewsbury; and a surprising number of iron arrow-heads were found at the bottom of the furrows, which, as Mr. Blakeway, a local antiquary, believed, were relics of the battle of Shrewsbury, in the year 1403, and no doubt had been originally left strewed on the battle-field.'

Among the memorials of a distant past examined for Mr. Darwin were the relics of the ancient city of Uriconium, the work being carried out by a zealous local antiquary, Dr. Johnson, of Shrewsbury. Trenches were dug in four fields, and it was ascertained that the depth of vegetable mould over the ruins varied from nine inches to forty.

'In many places where streets ran beneath the surface, or where old buildings stood, the mould was only eight inches in thickness; and Dr. Johnson was surprised that in ploughing the land the ruins had never been struck by the plough, as far as he had heard. He thinks that when the land was first cultivated the old walls were, perhaps intentionally, pulled down, and that hollow places were filled up. This may have been the case; but if, after the desertion of the city, the land was left for many centuries uncultivated, worms would have brought up enough fine earth to have covered the ruins completely; that is, if they had subsided from having been undermined. The foundations of some of the walls, for instance those of the portion still standing about twenty feet above the ground, and those of the market-place, lie at the extraordinary depth of fourteen feet; but it is highly improbable that the foundations were generally so deep. The mortar employed in

he buildings must have been excellent, for it is still in parts extremely hard. Wherever walls of any height have been exposed to view, they are, as Dr. Johnson believes, still perpendicular. The walls with such deep foundations cannot have been undermined by worms, and therefore cannot have subsided, as appears to have occurred at Abinger and Silchester. Hence it is very difficult to account for their being now completely covered with earth; but how much of this covering consists of vegetable mould and how much of rubble, I do not know. The market-place, with the foundations at a depth of fourteen feet, was covered up, as Dr. Johnson believes, by between six and twenty-four inches of earth. The tops of the broken-down walls of a caldarium or bath, nine feet in depth, were likewise covered up with nearly two feet of earth. The summit of an arch, leading into an ash-pit seven feet in depth, was covered up with not more than eight inches of earth. Wherever a building which has not subsided is covered with earth, we must suppose, either that the upper layers of stone have been at some time carried away by man, or that earth has since been washed down during heavy rain, or blown down during storms, from the adjoining land; and this would be especially apt to occur where the land has long been cultivated.

The facts gathered by experiment and observations during so many years Darwin thus sums up in his closing passage:

'When we behold a wide, turf-covered expanse, we should remember that its smoothness, on which so much of its beauty depends, is mainly due to all the inequalities having been slowly levelled by worms. It is a marvellous reflection that the whole of the superficial mould over any such expanse has passed, and will again pass every few years, through the bodies of worms. The plough is one of the most ancient and most valuable implements; but long before it existed the land was in fact regularly ploughed, and it still continues to be thus ploughed, by earthworms. It may be doubted whether there are many other animals which have played so important a part in the history of the world as have these lowly organized creatures.'

This book on 'Earthworms' closed the series of Mr. Darwin's great works; but in the course of the next few months he contributed some short papers to *Nature*, and a rather remarkable one to *Mind*, on the 'Psychogenesis of a Child.' It was his

good fortune to remain in harness to the last: he felt nothing of the weakened energies and decayed mental powers which are so often the grief and burden of our declining years. From weakness of the heart, however, he had experienced occasional trouble; and he had been under medical advice for awhile, when, at midnight on Tuesday, April 18th, he was attacked with severe internal pains, and the next afternoon, at four o'clock, closed in peace his long, laborious, and useful career. He was seventy-three years old.

[*Authorities:* 'Charles Darwin,' by Edward Woodall; 'Charles Darwin,' Memorial notices reprinted from *Nature;* 'Charles Darwin,' by Grant Allen ('English Worthies' series); Memoir in the *Times*, April, 1882; *Westminster Review*, 1882; J. H. Huxley, 'Evidence as to Man's Place in Nature;' St. George Mivart, 'On the Genesis of Species,' 1871; Herbert Spencer, 'Principles of Biology,' 1864-70; Sir Charles Lyell, 'Geological Evidences of the Antiquity of Man,' 4th edition, 1873; Quatrefages, 'C. Darwin et ses Précurseurs,' 1870; A. Wallace, 'Contributions to the Theory of Natural Selection,' 1870; Dr. Lionel Beale, 'Protoplasm,' 2nd edition, 1870; Professor Tyndall, 'Address to the British Association at Belfast,' 1874; John Fiske, 'The Idea of God as Affected by Modern Knowledge,' 1886—a religious view of Evolution and Darwinism.]

Chronological List of Darwin's Works.

'Journal of Researches into Natural History and Geology' (voyage of the *Beagle*), 1839.

'Structure and Formation of Coral Reefs,' 1842.

'Geological Observations on the Volcanic Islands,' 1844.

'Naturalist's Voyage round the World,' 1845.

'Geological Observations on South America,' 1846.

'Monograph on the Sub-class Cirripedia,' 1851-54.

'Origin of Species,' 1859, 1866, 1872.

'On the Contrivances by which Orchids are Fertilized by Insects,' 1862.

'On the Movements and Habits of Climbing Plants,' 1865.

'Variation of Animals and Plants under Domestication,' 1868.

'Descent of Man,' 1871.

'Expression of the Emotions in Man and Animals,' 1872.

'Insectivorous Plants,' 1875.

'Effects of Cross and Self-Fertilization in the Vegetable Kingdom,' 1876.

'Different Forms of Flowers on Plants of the Same Species,' 1877.

'Power of Movement in Plants,' 1880.

'Formation of Vegetable Mould through the Action of Earthworms,' 1881.