

Charles Darwin after One Hundred Years

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For the past three centuries man's physical and intellectual environment has been undergoing changes. Great masses of the population of the western world have failed to grasp the basic meaning of these changes and, as a result, are living under the dictates of a culture of the past.

Today as never before, man, due to his use of the scientific method in learning the secrets of the operation of the inanimate and animate world, has opened up a vastness of the universe which leaves us with a feeling of awe and reverence of the ultimate power back of it all.

Thinking men and women see changes occurring in the world today. They are agreed that the world about us is undergoing orderly change. They see mountains changed into valleys and seas filled by the erosive power of mighty rivers; how radioactive elements disintegrate to form new elements and how man is shrinking his universe at a frightening rate. All this change is, to the scientist, evolution. It is opposed to a belief in an unchangeable, fixed universe.

The fear of evolution in the minds of many people involves a fear of science in general. Unfortunately, those who have a fear of science hold that people should be kept in ignorance of the physical and organic world, since learning the ways of nature may be contrary to the beliefs which have come down through the ages. These views do not frequently make allowances for the changing times in which we live. We either find ourselves in a changing world or an unchanging one. If through the dictates of our own cogitation we are led to accept the view that the world is changing, we accept all that evolution implies; that is, that throughout nature there is an orderly change.

At this point I wish to emphasize the orderliness that is found in nature. Through the laborious research of great human minds we are now able to deduce that all changes are part of a great process that has no beginning and no end that are within our powers of comprehension. This concept was not easy to come by. It is the result of a painstaking struggle with nature. Charles Darwin was not thoroughly convinced of it when he began delving into nature's secrets. Just as evolution in the universe is a slow process, so its meaning and significance will be slowly grasped by man. Nevertheless, it is with few exceptions, the accepted view of scientists of the world. If there is an acceptance of universal and continuous change in all living and non-living matter, we are well on our way to looking at the contribution of some of the exponents of this line of thinking.

Today we pause to commemorate the contributions of one of these famous men—Charles Robert Darwin—an Englishman born on February 12, 1809, one hundred fifty years ago. It was also on February 12, 1809, on the same day, month and year, that another great world figure was born, Abraham Lincoln, an American; both emancipators, one of man's intellectual outlook, the other of man's body from the lash of a task master. Radical adjustments in the intellectual, spiritual, social, and biological philosophies and planning of man are the consequential results of the impact of the contributions of these liberators.

It was also just one hundred years ago today, November 24, 1859, that Darwin's epoch-making book, *On the Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life*, was published in London, England. The whole edition of 1250 copies was exhausted on the day of issue.

Charles Darwin was the son of Robert Darwin and the grandson of Erasmus Darwin. At the age of 16, Charles was sent by his father to Edinburgh to study medicine. He was not interested in medicine, so spent much of his time during the next three years attending lectures on Natural History and Geology under the direction of Professors Henslow and Sedgwick. In 1828, at the request of his father, he entered Christ College at Cambridge, from which he took a degree in 1831.

Darwin's interests were now as much in biology and geology as in divinity. He was thus eligible to become the naturalist of the famous British Expedition which was preparing to go around the world.

Young Darwin, age 22, received the appointment as naturalist due to the helpful influence of Professors Henslow and Lyell, and sailed from Devonport on December 27, 1831, in the *Beagle*, a ten-gun brig under the command of Captain Fitz Roy. He returned to England in October, 1836, at the end of the voyage which took him around the world. He had studied in South America, Galapagos Islands, Tahiti, New Zealand, Australia, Tasmania, St. Helena, and other Atlantic Ocean Islands. From 1838 to 1841 he was secretary of the Geological Society of England, during which time he spent many hours with Sir Charles Lyell, the great geologist of his time. In January, 1839, Charles Darwin married Emma Wedgwood, his cousin. They lived in London until 1842, when they moved to Down, Kent, 20 miles from London. They were the parents of 10 children; two daughters and five sons survived him. Four of their sons became distinguished scientists and members of the Royal Society of London. His wife was a good companion to him, helping him in his short working periods of two to three hours each day. His lack of stamina was owing to an illness he acquired during the five-year voyage of the *Beagle*. He died on April 19, 1882, and was buried in Westminster Abbey.

Charles Darwin grew up in a conservative intellectual climate. The theory of descent or transmutation was, however, being widely discussed by such men as Lamarck, Charles Lyell, Henslow, Hooker, and Sedgwick. Erasmus Darwin, Charles' grandfather, who died seven years before Charles was born, was an advocate of transmutation. Lyell, owing to his finding of rock strata and fossils, was advocating that the earth was much older than was generally maintained. As Darwin glimpsed the forest jungles of Brazil, he became fascinated by the splendor of the forests, birds, and insects. He learned how perfectly some species escaped destruction by camouflage or mimicry and how for ages the struggle for life had been going on. Great collections of plants, insects, birds, and fossils were collected and dispatched to England for future study. It was during his pensive moments that he began to realize that time and change were the essence of transmutation. The data he was gathering would be of value to him in the future. He was gathering the facts out of which he would be able to make his far reaching and lasting deduction.

After more than three years spent in South America, the *Beagle* arrived at the Galapagos Archipelago on September 15, 1835. Darwin had been looking forward to a study of the flora and fauna of these islands. It was here that he began to realize that isolation, competition, and time were some of the creative factors in the organic world.

The Galapagos Islands, situated on the Equator 500 miles west of Ecuador (which administers them) consists of 10 major and several small volcanic islands. These islands were discovered in 1535, and have been visited only by buccaneers, whalers, and some scientific collectors until recently, when the Ecuadorians established a penal colony on St. Charles Island. Since Darwin's visit in 1835, much disturbance of the fauna and flora has resulted from introduction of animals on some islands and the ruthless killing of the tortoises.

On these oceanic islands Darwin found a unique plant and animal world—a little cosmos—nothing like it any other place on earth. After spending five weeks surveying several of the islands, he made a most interesting report on his findings.¹ He believed the Archipelago was the result of volcanic action, which led him to classify it as oceanic islands. Information now available throws some doubt upon this conclusion, since Pliocene fossils have been unearthed on some of the islands. Disregarding the origin of the islands, Darwin found only one indigenous land mammal—a mouse—no amphibians, three most unique reptiles—the great land tortoises and two iguanas (one aquatic in habit, the other living entirely on the land)—and thirteen species of finches, as well as many other animals and plants.

The large tortoises are found on all the major islands and some of them grow to immense size. Darwin reports that some specimens require

six to eight men to lift them from the ground, and that they afford as much as two hundred pounds of meat. The males are larger than the females. The tortoises which live on the lower arid parts of the islands feed chiefly on cactus. Those which are found higher up on the mountains, where it is damp, eat leaves and berries found on various trees.

The tortoise is fond of water, drinking large quantities. Since springs are found only on the larger islands, situated well away from the shore in the central part, the tortoises from the low lands and shore areas have made well-beaten trails to the springs. The traders and buccaneers followed the trails to the watering places when collecting tortoises for a meat supply on their ships. Tortoises coming in from the low areas of the islands for water remain for several days at the springs. When one reaches the spring, Darwin reports, “. . . the head is buried in the water above the eyes and [it] greedily swallows great mouthfuls, at the rate of about ten in a minute.”²² For many days after a visit to the spring the urinary bladder is said to be distended with fluid. Many traders seeking water to quench their thirst drink the contents of the bladder if full.

The tortoises begin laying eggs in the fall, October. The eggs are white and a little larger than a hen's egg. They are usually laid together in the sand and covered over by the female. The eggs and meat of the tortoises are widely used by the inhabitants of the islands and by the whalers and the buccaneers in the past. Darwin reports that a single vessel has taken away as many as seven hundred, and that one ship company brought down to the beach two hundred tortoises in one day. A careful study of these interesting creatures has revealed that there were fourteen species or subspecies living in the archipelago. Some of them are now extinct owing to the slaughter of the adults and the killing of the young by introduced animals. Darwin did not appreciate at first the fact that there were fourteen species on islands. His attention was called to it by the vice-governor, Mr. Lawson, who declared “that the tortoises differ from the different islands and that he could with certainty tell from which island any one was brought.”²³

Before leaving the islands Darwin concluded that “there can be little doubt that this tortoise is an aboriginal inhabitant of the Galapagos; for it is found on all, or nearly all the islands, even on some of the smaller ones where there is no water; had it been an imported species, this would hardly have been the case in a group which has been so little frequented.”²⁴

The iguanas along with the tortoises are the most conspicuous animals on the islands. They are found no other place in the world. One species, *Amblyrhynchus cristatus*, when mature is three to four feet long and weighs 15 to 20 pounds. It feeds on sea-weeds and, when not swimming in the sea for food, basks in the sun on the lava rocks along the beach. The other species, *A. demarllii*, lives entirely upon the land, feeds only upon land

plants, is smaller than the marine species, and spends much of its time in burrows which it digs in the volcanic sand of the desert lowlands of the islands.

Darwin observes that “the aquatic species is by far the most remarkable, because it is the only existing lizard which lives on marine vegetable productions.”⁵

He also remarked, “We must admit that there is no other quarter of the world where this order (reptiles) replaces the herbivorous mammalia in so extraordinary a manner.”⁶

Since the thirteen species of Darwin’s finches on the Galapagos, plus one on the Cocos Island to the northwest, are such a self-contained group with no obvious relations elsewhere, I have chosen to report rather fully on their habits and evolution. Not only do they vary from island to island, but up to ten different species of them can be found on a single island. It is reasonably certain that all of the Darwin’s finches evolved from an original colonizing form. The close resemblance among the species in plumage, calls, nests, and eggs suggests that they have not yet had time to diverge far from one another. It seems clear that the beak differences among the several forms of finches are adaptive. Some of the differences are greater in some forms than in others. These finches furnish circumstantial evidence for the origins of new species by reason of geographic isolation.

David Lack has recently studied the Galapagos finches.⁷ The following notes are from his study:

If differentiated forms, such as the Darwin’s finches, are to persist along side each other as separate species, two conditions must be met. First they must avoid interbreeding, and second they must not compete for the same food. In the Galapagos Islands differentiation was possible because the original species could scatter and establish separate homes on the various islands. A similar group of birds which have evolved as the finches are the sicklebills of Hawaii, which are likewise on an Archipelago.

The 14 species of Darwin’s finches fall into four main genera. *First* there are the ground finches, embracing six species, nearly all of which feed on seeds on the ground and live in the arid coastal regions. *Secondly*, there are the tree finches, likewise including six species, nearly all of which feed on insects in trees and live in the moist forests. *Thirdly*, there is the warbler-like finch (only one species) which feeds on small insects in bushes in both arid and humid regions. *Finally*, there is an isolated Cocos Island species which lives on insects in a tropical forest.

Among the ground finches, four species live together on most of the islands: three of them eat seeds and differ from each other mainly in the size of their beaks, adapted to different sizes of seeds; the fourth species feeds largely on prickly pear and has a much longer and more pointed beak. The two remaining species of ground finches, one large and one small, live chiefly on the outlying islands, where some supplement their seed diet with cactus, their beaks being appropriately modified.

Of the tree finches, one species is vegetarian, with a parrot-like beak seemingly fitted to its diet of buds and fruits. The next three species are closely alike, differing primarily in body size and in the size of their beaks. A fifth species eats insects in mangrove swamps. The sixth species of tree-finch is one of the most remarkable birds in the world. Like a woodpecker, it climbs tree trunks in search of insects, which it excavates from the bark with its chisel-shaped beak. While its beak approaches a woodpecker's in shape it has not evolved the long tongue with which a woodpecker probes insects from crannies. Instead the tree-finch solves the problem in another way: it carries about a cactus spine or small twig which it pokes into cracks, dropping the stick to seize any insect that emerges. This astonishing practice is one of the few recorded cases of the use of tools by any animal other than man or the ape.⁸

Time will not permit a discussion of other elements of the fauna and flora. Suffice it to report that of the more than 400 species of plants reported on the islands more than 50 per cent of them are indigenous, and that there are 35 families of Coleoptera represented by 205 species of which far more than a majority are endemic.

Confronted by this array of new animals and plants, Darwin began to search for an explanation as to their origin. These islands as noted above are removed from the main land of South America; they are in the direct course of the Humboldt Current which, coming from the Antarctic region, makes the surface waters of the islands 15 to 20 degrees cooler than the nearby tropical sea; storms and strong winds rarely occur, and winter rains are light. The mountains of some of the islands rising to several thousand feet are usually covered by a mist, which makes possible the growth of trees and ferns. The lowlands and the shores are desert-like, with no continuous streams and very few springs, some of which are dry during most of the year. Let us see what Darwin was thinking about this problem. The following quotation is from his *Journal of Researches*:

The natural history of these islands is eminently curious and well deserves attention. Most of the organic productions are aboriginal creations, found nowhere else; there is even a difference between the inhabitants of the different islands; yet all show a marked relationship with those of America, though separated from that continent by an open space of ocean between 500 and 600 miles in width. The Archipelago is a little world within itself, or rather a satellite attached to America, whence it has derived a few stray colonists and has received the general character of its indigenous productions. Considering the small size of these islands, we feel the more astonished at the number of their aboriginal beings, and at their confined range. Seeing every height crowned with its crater, and the boundaries of most of the lavastreams still distinct, we are led to believe that within a period geologically recent the unbroken ocean was here spread out. Hence, both in space and time, we seem to be brought somewhat near to that great fact—that mystery of mysteries—the first appearance of new beings on this earth.⁹

Reviewing the facts here given, one is astonished at the amount of creative force, if such an expression may be used, displayed on these small, barren and rocky islands; and still more so at its diverse yet analogous action on points so near each other. I have said that the Galapagos Archipelago might be called a satellite attached to America, but it should rather be called a group of satellites, physically similar, organically distinct, yet intimately related to each other, and all related in a marked, though much lesser degree, to the great American continent.¹⁰

Darwin returned to England in a questioning attitude. He began at once to organize his voluminous notes and study the fossils and biological specimens collected during the voyage. In 1839 he set forth in an interesting and challenging way some of the results and experiences of the five years spent on the *Beagle*. The book, *A Naturalist's Voyage Around the World*, brought fame to Darwin as a naturalist and developed in him a determination to spend his life in zoological research. He determined to study the transmutation of living organisms and if possible arrive at some satisfactory explanation. In 1838, while he was reading Malthus on "Population," the idea of natural selection flashed upon him, thus providing a theory with which to work. Even with his decision to use natural selection as a major factor in explaining the fact of evolution he made slow progress. In 1842 he wrote a thirty-five page statement on the theory of the descent of animals, but put it aside until he could get more supporting data. Again, in 1844, he added materially to his first statement in a 230-page abstract of his thinking on evolution.

A letter from Alfred Russel Wallace in early 1858 came as a shock to Darwin and ended his procrastination in the publishing of his *Origin of Species*. Wallace, a careful field worker and well-trained biologist, had arrived at a similar conclusion as had Darwin as to the role played by natural selection in evolution. After a discussion on this matter with Lyell and Hooker it was agreed that a joint communication of the views of Darwin and Wallace should be published in the July number of the *Journal of the Linnean Society*. This done, it was then important that Darwin should finish his study and publish the *Origin of Species*. After 13 months of painstaking writing and editing he published his greatest contribution, the *Origin of Species by Means of Natural Selection*.

There was a mixed reaction to it. Some notables as Sir John Herschel, Adam Sedgwick, and Bishop Wilberforce were outspoken in their opposition to it. It was supported by such leaders as Hooker, Lyell, Wallace, Alfred Newton, Huxley, and Spencer.

After one hundred years Darwinism is widely accepted by scientists of the world. Through his careful efforts Charles Darwin established evolution as a fact; and subsequent workers have pointed out that natural selection,

isolation, variation, and heredity operating over long periods of time provide the methods or factors for evolution. The plants and animals we see today are the results of changes that have been wrought in pre-existing forms by the above-mentioned factors. Thus we conclude that Darwin made two major contributions: first, he established evolution as a fact; second, he advanced natural selection as an important factor in the process. He had the following to say about natural selection: "This preservation of favorable individual differences and variations, and the destruction of those which are injurious, I have called Natural Selection, or the Survival of the Fittest."¹¹ Darwin contended throughout his writings that evolution in the biological world has been slow and orderly and the results of long periods of time. This contention has been supported by additional evidence from the several disciplines such as comparative anatomy, embryology, classification, paleontology, geographical distribution of animals, genetics, geology, physiology and psychology. Evidence to support an orderly change from older species to more recent ones has especially come from the fields of classification, paleontology, and geographical distribution. Natural selection and isolation as extrinsic factors in the method of evolution are clearly evident in the life on the Galapagos Islands.

Charles Darwin's contributions have done more to unify the biological sciences than those of any other man. Likewise, the impact of Darwinism has been felt in almost all fields of science and learning. Such subjects as psychology, history, sociology, astronomy, and anthropology have been benefited and given new direction. With new facts and forces and instruments of precision at our disposal we have within our grasp the means of more thoroughly controlling our universe.

In this discussion we have not commented on man's relationship to the higher animal species. In conclusion it may not be out of place to make the following comments. From a biological and philosophical point of view, there can be no question but that man is related in a physical way to the animals. His structure, physiology, embryology, and heredity make him one of them. But he is much more than an animal: he has psychic and spiritual characteristics which need to be explained as much as the evolution of his body. If we accept the deduction presented at the beginning of this paper that all changes are part of a great process that has no beginning and no end, and that there is an orderly change which runs through the universe, there is reason to believe that there are possibilities of our some time growing or evolving to a place at which we more clearly understand the God of this universe and the divinity that is within us.

Dr. Tanner is professor of zoology and entomology at Brigham Young University. He read this paper before the staff members and students of the College of Biological

and Agricultural Sciences of Brigham Young University, and the Weber College Faculty Association on November 23 and 24, 1959.

1. *Journal of Researches*, 1901 (New York: C. F. Collier and Son), chap. 17.
2. *Ibid.*, p. 433.
3. *Ibid.*, p. 445.
4. *Ibid.*, p. 435.
5. *Ibid.*, p. 441.
6. *Ibid.*
7. David Lack, "Darwin's Finches," *Scientific American*, April, 1953.
8. *Ibid.*
9. *Ibid.*, pp. 427–428.
10. *Ibid.*, p. 450.
11. Charles Darwin, *The Origin of Species*, Vol. I, p. 98. International Science Library, A. L. Fowle, New York.