

DARWINIAN EVOLUTION

Between June and November 1840, Darwin chanced, in his recreational reading, upon a genetic algorithm (the artificial selection of words randomly generated by tossing wooden blocks in a frame) used by the Professor in Speculative Learning and his 40 graduate students at the Grand Academy of Lagado, by which

the most ignorant person may write books with-out the least assistance from genius or study.

Six hours a day the young students were employed in this labour, and the professor showed me several volumes in large folio already collected, of broken sentences, which he intended to piece together, and out of those rich materials to give the world a complete body of all arts and sciences; which might however still be improved, and much expedited, if the public would raise a fund for making and employing five hundred such frames in Lagado, and oblige the managers to contribute in common their several collections.”
—*Gulliver’s Travels*, 1726.¹

e10 Galápagos Islands < finches, wrens, ‘Gross-beaks’, and blackbirds >

Darwin had [been] puzzled by certain anomalies. Why did species on oceanic islands resemble those of neighbouring continents, with African-like species in the Cape Verde Islands and South American-like species in the Galápagos Islands? Since the Galápagos and Cape Verde Islands had similar physical conditions, why didn’t God create the same animals for them both?

—Deborah Cadbury in *Terrible Lizard*.²

... mystery of mysteries [In a letter from Cape Town, South Africa, early in 1836, astronomer John Herschel had suggested to Lyell that the replacement of extinct species be the ‘mystery of mysteries’ for natural science³ and he likely used this phrase when Darwin visited him during the *Beagle* port-of-call there, June, 1836.⁴]—the first appearance of new beings on this earth. —Darwin, *Origin*.

When Darwin published his *Origin of Species* (1859), it seemed at first to be just another theory to add to the many already available, none of which was generally considered satisfactory. But one novel feature was its emphasis on what was soon dubbed the ‘struggle for existence,’ in contrast to the more traditional emphasis on the harmony of the natural world.
—Martin John Spencer Rudwick.⁵

Today, the Galápagos (Spanish for tortoises, which for long there were the main source of meat for visiting sailors and landed islanders) are populated, among other things, with 11 different taxa (survivors of 15 taxa originally noted) of giant tortoises (*Geochelone nigra*) of different shell shapes on different islands, and 13 non-migratory finch species (not all seen by Darwin, and not John Gould’s 13) grouped as three genera of *tree-living finches* distinguished by those that eat fruits and bugs, are strict vegetarians, and look and act like warblers, and a fourth genera, its members often seen hopping about of the ground, of *ground finches* (*Geospiza*) of six species: sharp-beaked, *G. dicilis*; cactus finch, *G. scandens*; large cactus finch, *G. conirostris*, and covarying in body and beak: large *G. magnirostris*; medium *G. fortis*; and small *G. fuliginosa*.⁶ The variety of habitats that finches occupy in the Galápagos are not competed for by other species, as these are by flycatchers, parrots, and toucans, on the continent of South America. In South America only one related finch species, the blue-black grassquit, *Volatinia jacarina*, exists.

The Galápagos (**Figure e10.1**) are islands of a volcanic archipelago, isolated in the Pacific Ocean, 1000 km west of Ecuador. They date from the Miocene in age. Being volcanic they were barren when formed. The now visible islands emerged about 9 million years ago. Sunken older ones dated so far, were emergent some 14.5 million years ago. Modern genetic studies, by Hampton L. Carson, of the two iguana species on the islands is that they had a common ancestor 15 to 20 million years ago.⁷

Charles Robert Darwin (**Figure e10.2**) as naturalist on the 1831-1836 “voyage round the world” aboard *H. M. S. Beagle* captained 1826-1836 by Robert Fitz Roy (**Figure e10.3**), collected from several of the Galápagos islands, tortoises, and small songbirds of which he bagged 4 mockingbird and 31 finch specimens to establish the diversity within the species that existed in the archipelago with the presumption that “When I see these Islands in sight of each other, & possessed of but a scanty stock of animals, tenanted by these birds, but slightly differing in structure & filling the same place in Nature, I must suspect they are only varieties” (**Footnote e10.1**). The *Beagle* docked in

Falmouth in October 1836. In his opinion, the biological specimens he had collected during his voyage were of interest, but of no great significance, and on January 4, 1837, he donated them to the Zoological Society of London after a meeting at which he had shown his Galápagos birds as specimens of “finches, wrens, ‘Gross-beaks’, and blackbirds.” These same birds he had taxidermied were then classified according to Linnaean principles by ornithologist John Gould (**Figure e10.4**). Within weeks Gould could formally declare “a series of Ground Finches, so peculiar in form that he was induced to regard them as constituting an entirely new group containing 14 [later revised to 13] species, genus *Geospiza* [which genus name “ground finches” is now restricted to 6 of the species], and appearing to be strictly confined to the Galápagos Islands.”⁸ Gould accounted for the variation by adaptation to different circumstances but each species remained fixed as designed by the Creator in the set of homologies that Richard Owen persuaded allows for discovery of its *archetype* (this last, Darwin would come to change to *common ancestor with other species*).

Why had Darwin, who new of Lamarck’s theory of evolution, not recognized that to be a possibility? Johathan Weiner in *The Beak of the Finch*, 1994,⁹ suggests he was prejudiced against such speculation by Lyell’s *Principles of Geology* that, at Henslow’s urging, Fitz Roy bought for the ship’s library: The 1st edition’s *volume 1* (appeared in London, January 1830) deals with physical geology. This was in Darwin possession (it bears the inscription, “From Capt Fitz Roy”—probably to Henslow who, originally invited, had deferred to his wife’s do-not-go wish) when Darwin, a bachelor (whose only known received love letters had been from Fanny (daughter of Wm. Mostyn Owen)¹⁰ in 1828), boarded the *Beagle*, December 1831. Henslow mailed to ports in South America *volume 2* (received at Montevideo, appeared in London, January 1832), which expounds on the fixity and extinctions of species, and *volume 3* (received at Valparaiso, appeared in London, 1833), which describes the historical geology of the Recent and Tertiary as Lyell recognized these. Darwin had himself received John Herschel’s *A Preliminary Discourse on the Study of Natural History*, 1830,¹¹ and this had put him on a similar tack to identify what natural laws reveal themselves in the workings of biological systems. Lyell’s textbook summation of the value of Lamarck’s theory was that “It is idle to dispute about the abstract possibility of the conversion of one species into another when there are known causes, so much more active in their nature, which must always intervene and prevent the actual accomplishment of such conversions.” But Lyell neglects to say what those known causes are and Darwin’s own field observations did not alerted him to Lyell’s omission and his further (false, though standard for the time) essentialist (stemming from Plato) assumption that “There are fixed limits beyond which the descendants from common parents can never deviate from a certain type.”

Weiner writes, “That is why Darwin dropped the finches from [the first visited] two Galápagos islands into one bag. Like Linnaeus he was well aware [as botanist Henslow had schooled him] that different local conditions can carve a species into local varieties. He and Fitz Roy had already seen evidence of that in the foxes of the Falkland Islands, and Darwin thought he saw the same thing in Galápagos rats. But Darwin did not imagine that a species would split into different varieties under the near identical conditions and skies of neighboring islands; even if they had, Darwin did not imagine that such varieties would mean anything all that important [although the plant varieties that he collected, destined for Henslow’s *Catalogue*, he carefully labeled by date and by place].”¹²

To explain the variety of plants and animals in the Galápagos, Darwin, later in the 1830s, rejected the theological principle of the fixity of species: “such colonists would be liable to modification—the principle of inheritance still betraying their original birthplace.” *Hypothesis*: The descendants of pioneer finches from South America have evolved and have island hopped and evolved (**Footnote e10.2**) to fit unoccupied ecological niches in the Galápagos. The Voyage’s main funding was for finding longitudes of far-flung lands. For this, Fitz Roy tended to no less than 23 chronometers (half for the Admiralty, for others, and six that he owned). Spot checks of longitude were obtained by the laborious lunar distance method. Like Darwin, but at times of leisure, he also made collections of finches. Unlike Darwin, captainlike he recorded from which islands his specimens were collected. For this vital information, Darwin, later, cap-in-hand asked for and received the collection from generous, if mercurial, enduring friend, Fitz Roy (who found odious any advocacy for evolution).

A possibility not settled by Darwin, and which needs the perspective of genetics is: Is the South American seed-eating ground finch species in fact the persisting ancestral finch stock or is it a finch population of decreased diversity?

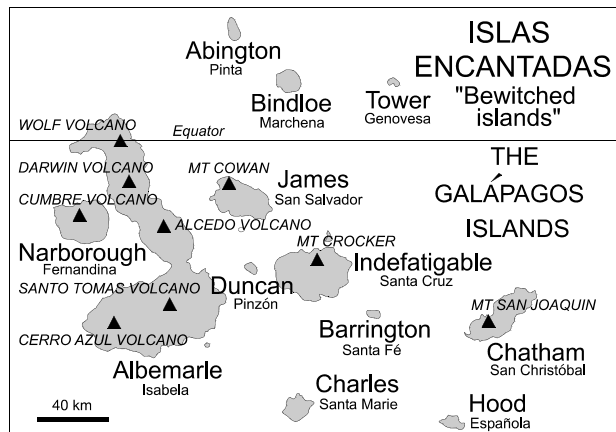
Field and genetic studies by Peter and Rosemary Grant beginning in 1973 finds that the Geospizine species (Darwin’s finches) evolved during 2-3 million years in the Galápagos from a seed-eater founder related to non-migratory tanagers that now range the Caribbean, Central and S. America.¹³

Darwin June 1837 started keeping his pocket-notebook “B” on *Transmutation of Species* in 1837¹⁴ and on its first page he wrote in homage to his grandfather Erasmus as a heading “Zoomania” and in which work Erasmus had written: “Animals differ in countries in exact proportion to the time they have been separated. Countries longest separated, greatest differences.” (Desk-notebook “A” begun about then too, deals with geology.) In *Chapter 9* of *Transmutation* he ponders the existence of “Abortive Organs” (rudimentary or vestigial structures as ear muscles for wiggling, nictitating membrane of eye and male mammae in humans, teeth in the upper jaws of embryos in whales and ruminants, rudiments of pelvis and hind limbs in snakes, and wings on many flightless birds). And what of extinctions (that the fossil succession made implicit) if forms were created for this world? Such did fly in the face of natural theologian’s certitude of creation’s perfection.

Darwin’s first inkling that adaptation could be the natural result of spoils to the victor was when during six days reading, begun 28 September 1838, he had stirred into the mix of his thoughts Malthus’s *Essay on Population*, 1798,¹⁵ primed, as he surely was, by his grandfather Erasmus Darwin’s poem (scandalous at the time for its espousal of natural law and transmutation of species): *The Temple of Nature*,¹⁶ 1803, with passages as “Organic Life beneath the shoreless waves / Was born and nurs’d in Ocean’s pearly caves; / First forms minute, unseen by spheric glass, / Move on the mud, or pierce the watery mass; / These, as successive generations bloom, / New powers acquire, and larger limbs assume; / Whence countless groups of vegetation spring, / And breathing realms of fin, and feet, and wing.” Darwin then formulated his thesis: “being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved and unfavourable ones to be destroyed. The result of this would be the formation of new species.”

By 1844, letters (Janet Browne in preparing to write *Charles Darwin*, 2002, perused some 14,000 of them!)¹⁷ to his friends, such as botanist Joseph D. Hooker, reveal that Darwin had fixed on an external mechanism of natural selection (on which he would delay fifteen years to publish) as being the cause of evolutionary advance and had rejected that there be any innate (internal) life force for the same: “With respect to books on the subject, I do not know of any systematical ones except Lamarck’s, which is veritable rubbish.” The subject Darwin rejected was Lamarckian vitalism (that organic beings could change by exercising their will on a metaphysical force) and not Lamarck’s (then acceptable, but false)¹⁸ view that acquired physical characteristics are inheritable (**Footnote e10.3**). And surely he was also thinking of Robert Chambers’s best selling *Vestiges* anonymously published in 1844 (and outselling *Origin*, after it appeared in 1859, until the 1880s) that in subversive contradiction to the “truth of revealed religion,” found for spontaneous generation and gradual “unfolding” of “higher” life forms in an ongoing “gestatory” process in the actuality of “parallelism” between embryonic development, the stratigraphic record, and the principal features of animal classification. James Secord rescues this history in *Victorian Sensation: The Extraordinary Publication, Reception and Secret Authorship of Vestiges of the Natural History of Creation*, 2001,¹⁹ and unintentionally makes Loren Eiseley’s well-known phrase of “Darwin’s century” for the nineteenth²⁰ an irony. □

Figure e10.1²¹ The Galápagos archipelago of extinct and dormant volcanoes (triangles) (the last major eruption was from Alcedo on Isabela about 88,000 years ago) is positioned across the equator 1000 km west of Ecuador and is maintained by that country as a 250,000 km² marine-reserve biosphere. Marine iguanas, giant land tortoises, and tropical seabirds, stare back with indifference at the infrequent human visitor. Exotic seabird giants (blue-footed boobies and waved albatrosses) make their ungainly landings unperturbed. Of the 17 primary islands, Darwin visited in turn only Chatham, Charles, southern Albemarie, and Indefatigable.



To get ashore, visitors must step over sleeping sea lions and marine iguanas some basking whilst others, along with penguins, can be seen feeding in the shallows. The island have no coral reefs and no atolls exist in the widely open sea between. Near islands, scuba diving is hazardous by virtue of both surge and currents. June through October, water temperatures, never warm as in a coral sea, fall to a cool 22-17 °C. Sea lions and penguins, species more indigenous to cooler regions, live virtually side by side with a host of sharks, reef fish and sea turtles commonly found in more tropical climates. Walt Sterns writes: "Huge boulders and step-shaped ledges composed of volcanic rock follow the bottom's progression down a steep slope. Most are covered with tiny barnacles sharp enough to do a nasty. But the island's big-ticket show-offs make it worthwhile—Galápagos silky and whale sharks, schooling hammerheads, bottlenose dolphins, sea turtles, eagle rays, and schools of tunas and jacks."

Figure e10.2 Charles Robert Darwin (1809-1882) was born into comfortable circumstances as the fifth child (second son) of Dr. Robert Waring Darwin (1766-1848) (his mother, Susannah, daughter of the wealthy potterer Josiah Wedgwood, had died when he was eight and was remembered with love). His father, a successful physician (and shrewd money lender), Shrewsbury (a Welsh Border town, Shropshire, England), hopeful that Charles could be so too, sent him at age just shy of sixteen to Edinburgh University to study medicine (still Hippocratic humoralism that today is politely called "alternative" or "complementary" medicine, of the sort advocated by Benedict Lust—pronounced "Loost," his admirers tirelessly insist).²² Witnessing the surgical removal of limbs, and hearing the screams and cursing of the unanaesthetized in such procedures, persuaded Darwin to a more benign career. (Ether, the first modern anaesthetic, was recommended to surgeons by Crawford Young, a young medical doctor in Jefferson, GA, who noticed in 1842 that those injured in "riotous ether frolics," which he conducted, were unaware of pain, when, stumbling about, they wounded themselves.)²³ Gentlemen could purchase parsonages and in preparation for that his father, though himself an unbeliever and worldly son of the freethinker Erasmus Darwin (in whose circle moved feminist Mary Wollstonecraft), transferred Charles to study theology at Cambridge University (best for aspiring priests and lawyers—while Oxford University was for poets and politicians).²⁴ Darwin, from Prof. John Stevens Henslow (1796-1861, "I fully believe a better man never walked this earth"—Darwin in a letter to J. D. Hooker, May 18, 1861) (botany, mineralogy) received the message (ironic in hindsight: "it revolts our understanding")²⁵ that nature was benign and devoted his time to the pursuit of mostly beetle collecting, occasional horse riding & small-game shooting, with others of an outdoorsy bent.²⁶ Graduated and with some strings having been pulled for this genial young man by Henslow, by sponsor of the expedition Navel Hydrographer (one who charts coastlines and soundings, different from a cartographer who maps land and structures) Francis Beaufort (eponym for favored wind scales), and by Josiah (his uncle "Jos") Wedgwood II's push addressed to his father: "The pursuit of Natural History, though certainly not professional, is very suitable to a clergyman," he, at twenty two, was away, with his father's well wishes (and money sent so that he could hire the ship's boy, ~16 yr old, fast learning and ambitious, Syms Covington (ca.1813-1861) as his servant),²⁷ on what would be any naturalist's dream, a trip round the world (on the *HMS Beagle* that, he confided when he first saw it, "looked more like a wreck than a vessel commissioned to go round the world").



Whilst on the *Beagle* voyage, he recalled being often "heartily laughed at by several of the officers for quoting the Bible as an unanswerable authority on some points of morality."

Ashore, his geological hammer swung missed no rock (he had learned field-geology rudiments from Prof. Sedgwick), dragged left no dung beetle unfound for a stool unturned, thrown killed innumerable birds (some he taxidermied as remunerated and befriended freedman John Edmonstone had skilled him at the Edinburgh Museum), and once a curious fox "less wise, than the generality of its brethren."²⁸

After his return to England, 2 October 1836, he learned (inadvertently) from specialists, as the ornithologist John Gould, that the biological specimens he had collected (during his 5-year voyage begun, 27 December 1831), could provide evidence, "I am almost convinced," (but not till 1844 did he confide this to Hooker)²⁹ "... that species are not (it is like confessing a murder) immutable." The slain canon that had sat companionably when he had dined at Cambridge with Prof. Whewell (1794-1866) was: "Species have a real existence in nature, and a transition from one to another does not exist."³⁰

“It never struck me how illogical it was to say that I believed in what I could not understand and what is in fact unintelligible. I might have said with entire truth that I had no wish to dispute any dogma; but I never was such a fool as to feel and say ‘I believe that which is incredible.’”

—these words were, his daughter Henrietta (Etty) later revealed, edited out of Darwin’s 1876 autobiography manuscript (addressed by this philoprogenitive man to his grandchildren and so private), by his wife Emma (a first cousin, daughter of Josiah Wedgwood, and a Unitarian) and his 3rd son (of 4) Francis (Frank) (1848-1925), for its posthumous general publication.³¹

Darwin had suffered much from seasickness and under sail on a long voyage then had all the pleasure, as a wit of the time quipped, “of being in goal with the chance of drowning.”

In his later years (although his schoolboy-given nickname “gas” gives one pause as to the when), he would be discomforted by a malaise of aches, dizziness, indigestion and flatulence, a syndrome that onset chronically in South America while on a two week expedition up into the Andes from Valparaiso, Chile (and which a modern doctor could diagnose, though not without contention, as say Crohn’s disease³² but not Chagas’ disease³³ from a South American Trypanosomatidae—parasitic protozoans most of which, for the impoverished, yet cause high-morbidity and disfigurement).³⁴

For Darwin, who wondered if his union with a close relative had in some way contributed to the early death at age ten of his first daughter, Annie, due to an undiagnosed malaise, an enlightenment by Ann Parchett in the *Sunday New York Times Magazine* 4.28.02 comes too late “... the country folk in the film ‘Deliverance’ were not the product of parents who failed to take the initiative to go any farther than their aunt and uncles’ houses to look for a spouse. An article published recently in *The Journal of Genetic Counseling* says that the increased risk of birth defects to children born of first cousins are nominal. This isn’t exactly breaking news, either; the research has been in for some time. Could it be that we are so unnerved by the idea of the union of cousins that we didn’t even want to hear about it? The fact that marriage between first cousins is illegal in 24 states will probably go the way of laws that banned interracial marriage³⁵ and made a closet miscegenationist of Clarence King.

Figure e10.3³⁶ **Robert Fitz (= bastard) Roy (= King) (1805-1882)**, when Captain of the *HMS Beagle* “which was, as a result of its design, so susceptible to capsizing that the sailors of the Royal Navy called this class of ships ‘coffins.’ But not with Robert Fitz Roy in command. Fitz Roy in the *Beagle* [on the voyage before that on which Darwin would accompany him as a gentleman companion in spite of near rejection at their first meeting for his pug-nose that physiognomist Fitz Roy read as indicating a weak and lazy nature] had doubled Cape Horn, he had fought off the worst of the storms; he had sailed around the Cape of Good Hope and across most of the seas of the world; and the men who served under him now all acknowledged that their lives were dependent upon him.



“In this year of 1830 Captain [then with the official rank of commander not captain which promotion he would receive just prior to the voyage with Darwin] Fitz Roy was on the cutting edge of modern science and his cabin was filled with the latest gadgets, called barometers. One of the secrets of his success was that from the barometers he could tell when a storm was imminent and consequently was never caught by surprise. Then his orders were rapid and sure—and his mainsails were furled, his ship headed into the wind, when the hurricane’s fury which would have capsized an unprepared ship fell upon it.

“Fitz Roy was an English aristocrat, descendant of a bastard of Charles II [a fourth great grandson to him], the rakehell king; he was an exemplary representative of the energized elite that had established England’s dominance and had now maintained it for two hundred fifty years.”

—Richard Lee Marks, *Three Men of the ‘Beagle’*, 1991.

However, like Lord Palmerston who could utter that “every class of society accepts with cheerfulness the lot which Providence has assigned it,”³⁷ his insensitivity to the plight of slaves in Rio provoked to outrage Darwin who was then and ever for abolition.

In Plato’s *The Republic* we find:³⁸

And the pilot likewise, in the strict sense of the term, is a ruler of sailors and not a mere sailor.

That has been admitted.

And such a pilot and ruler will provide and prescribe for the interest of the sailor who is under him, and not for his own or the ruler’s interest?

To this question Fitz Roy’s “Yes” is evident in that, though criticized for the expense, he had for the second voyage, Benjamin Franklin’s newly invented lightning rods, grounded by a cable to the sea, installed on the masts of the *Beagle*.

Figure e10.4 John Gould (1804-1881)³⁹



The ornithologist who formally classified Darwin’s finches in 1837 and informed him that endemic species collected from three different Galápagos islands were 3 of mockingbirds genus *Mimus* and 14 (revised to 13—not the 13 now listed for the Galápagos) of finches genus “*Geospiza*” (now restricted to 6 species of “ground finches”).

This key information set Darwin on a course (traced by Frank J. Sulloway in 1979)⁴⁰ to arrive first at a concept of speciation in geographical isolation, and then, of speciation due to specialization within habitats, as for all is the Malthusian struggle for survival.

“Owing to this struggle, variations, however slight ... if they be in any way profitable to the individuals of a species ... will tend to the preservation of such individuals, and will generally be inherited by the offspring ... I have called this principle, by which each variation, if useful, is preserved, by the term Natural Selection.”

—Darwin, *On the Origin of Species*, 1859, with one illustration (an abstract diagram of branching evolutionary descent).

Footnote e10.1

Most botanists before 1859 believed that each plant species had a fixed central type, and that variation from type was a transient response to environmental stimuli. A transplanted species would vary to conform to its new environment, or die if conditions were too alien. Return an environmentally induced variety to its aboriginal environment, and it would revert to type. Variation, although ubiquitous, could not lead to evolutionary change because it was both inconstant and tightly bounded. [Hewett Cottrell Watson, botanist and author of *Cybele Britannica* (1847–59),] accepted this conventional wisdom with a caveat. He suspected that if variation persisted for an unspecified period of time, it became fixed, through some unspecified process, as a new central type. In this way, variation could accumulate to produce new species. ... When ... Watson finished reading a presentation copy of Charles Darwin’s *On the Origin of Species* (1859), he could not contain his enthusiasm. ‘You are the greatest Revolutionist in natural history of this century,’ he wrote excitedly to Darwin, ‘if not of all centuries.’ —Richard Bellon in his review of *Hewett Cottrell Watson* by Frank N. Egerton (2003).⁴¹

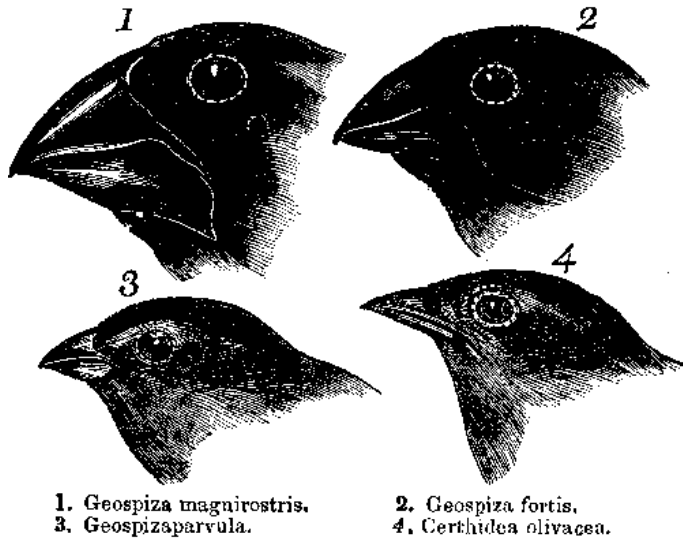
Footnote e10.2 Excerpt from Darwin’s *Journal of Researches*, pp.145-148, Vol II, 1846.⁴²

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 lava-streams 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 world.

Of terrestrial mammals, there is only one which must be considered as indigenous, namely, a mouse (*Mus Galapagoensis*), and this is confined, as far as I could ascertain, to Chatham Island, the most easterly island of the group. It belongs, as I am informed by Mr. Waterhouse, to a division of the family of mice characteristic of America. At James Island there is a rat sufficiently distinct from the common kind to have been named and described by Mr. Waterhouse; but as it belongs to the old-world division of the family, and as this island has been frequented by ships for the last hundred and fifty years, I can hardly doubt that this rat is merely a variety, produced by the new and peculiar climate, food, and soil to which it has been subjected. Although no one has a right to speculate without distinct facts, yet even with respect to the Chatham Island mouse, it should be borne in mind that it may possibly be an American species imported here; for I have seen in a most unfrequented part of the Pampas a native mouse living in the roof of a newly-built hovel, and therefore its transportation in a vessel is not improbable: analogous facts have been observed by Dr. Richardson in North America.

Of land-birds I obtained twenty-six kinds, all peculiar to the group and found nowhere else, with the exception of one lark-like finch from North America (*Dolichonyx oryzivorus*), which ranges on that continent as far north as 54°, and generally frequents marshes. The other twenty-five birds consist, firstly, of a hawk, curiously intermediate in structure between a buzzard and the American group of carrion-feeding *Polybori*; and with these latter birds it agrees most closely in every habit and even tone of voice. Secondly, there are two owls, representing the short-eared and white barn owls of Europe. Thirdly, a wren, three tyrant flycatchers (two of them species of *Pyrocephalus*, one or both of which would be ranked by some ornithologists as only varieties), and a dove—all analogous to, but distinct from, American species. Fourthly, a swallow, which, though differing from the *Progne purpurea* of both Americas, only in being rather duller coloured, smaller, and slenderer, is considered by Mr. Gould as specifically distinct. Fifthly, there are three species of mocking-thrush—a form highly characteristic of America. The remaining land-birds form a most singular group of finches, related to each other in the structure of their beaks, short tails, form of body, and plumage: there are thirteen species, which Mr. Gould has divided into four sub-groups.

All these species are peculiar to this archipelago; and so is the whole group, with the exception of one species of the subgroup *Cactornis*, lately brought from Bow Island, in the Low Archipelago. Of *Cactornis* the two species may be often seen climbing about the flowers of the great cactus-trees; but all the other species of this group of finches, mingled together in flocks, feed on the dry and sterile ground of the lower districts. [Not observed by Darwin, as the dry season progresses they separate when pickings become scarce. Then their different beaks are revealed to be survival-adapted to different foods]. The males of all, or certainly of the greater number, are jet black, and the females (with perhaps one or two exceptions) are brown. The most curious fact is the perfect gradation in the size of the beaks in the different species of *Geospiza*, from one as large as that of a hawkfinch to that of a chaffinch, and (if Mr. Gould is right in including his sub-group, *Certhidea*, in the main group), even to that of a warbler. The largest beak in the genus *Geospiza* [in



the drawings by Gould] is shown in Fig. 1, and the smallest in Fig. 3; but, instead of there being only one intermediate species, with a beak of the size shown in Fig. 2, there are no less than six species with insensibly graduated beaks. The beak of the sub-group *Certhidea* is shown in Fig. 4. The beak of *Cactornis* is somewhat like that of a starling; and that of the fourth sub-group *Camarhynchus*, is slightly parrot-shaped. Seeing this gradation and diversity of structure in one small, intimately-related group of birds, one might really fancy that, from an original paucity of birds in this archipelago, one species had been taken and modified for different ends. In a like manner, it might be fancied that a bird originally a buzzard had been induced here to undertake the office of the carrion-feeding *Polybori* of the American continent.

Footnote e10. Darwin in *Origin* (wrongly): “I think there can be little doubt that use in our domestic animal strengthens and enlarges certain parts and the disuse diminishes them; and such modifications are inherited.” However, this shorn version of Lamarck’s mechanism for organic evolution was the essence of neo-Lamarckism; term coined in 1885 by entomologist and invertebrate zoologist Alpheus Spring Packard, Jr. (1839-1905) for “prairie grass” (rather than “Darwinian branching”) orthogenetic evolutionary patterns that paralleled ontogeny.⁴³