



Darwin's Day

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I am writing this on February 12—Charles Darwin's birthday. He would be 199 years old. In just another year, we will celebrate in many ways his 200th birthday. Societies, institutes, and people all over the world will do this, almost always to honor him for his biological achievement. Yet, had he never written a word about evolution, barnacles, or other biological topics, he still would be famous for his geological contributions. All geologists and paleontologists know that we owe him a great deal—far too much to enumerate here, of course. Many of us honor him by celebrating his birthday, and around Berkeley we are no exception. Today we had cakes in different departments, museums or labs, with his name, finches, iguanas or, less creatively, worms emblazoned on them with different-colored icings. We had special lectures, always with more than one speaker because everyone wants to be in on his birthday. We even had a photo contest for the “best Darwin picture” (of any sort). My iguana did not win, instead some bug did, but there were lots of other photographic subjects too, loosely connected with the great man.

Other colleagues honor him continuously by collecting his books, citing his writings, visiting his tomb in the north aisle of Westminster Abbey whenever they visit London, tracking his steps through the Galapagos, or perusing his notes in the Cambridge library (no one wants to admit they just read the reprint).



Walking in Darwin's footsteps. Beach-goers play on the black sand beach in Matavai Bay near Point Venus, probably none realizing they had walked where Darwin, and indeed, Cook and Bligh had walked more than 170 years previously. On November 17, 1835, Captain Fitzroy set up instruments on Point Venus (to the left of the picture), where Lieutenant (later Captain) Cook took his observations of the transit of Venus across the sun 66 years earlier, to make navigational measurements. Darwin took advantage of the time by climbing the valley in the background to a spot “between 2000 and 3000 feet” from which he made his observations of the island of Eimeo (Moorea today) and its reef, as an engraving in a frame, the breakers on the reef representing the frame, the smooth lagoon the marginal paper, and the island itself the drawing.

Probably the most dedicated of these admirers was Irving Stone (http://en.wikipedia.org/wiki/Irving_Stone), not a paleontologist, but a renowned biographical novelist whose great book *The Origin* recounts Darwin's life and adventures with literary acumen. To write this book, Stone set out to understand Darwin like no other could have since the man himself had lived some 170 years before. Stone traveled to all the places Darwin had gone on the *Beagle* except for Tierra del Fuego. He slept in Down House for two weeks, wrote on Darwin's green felt-covered writing board, spent more than two years reading Darwin's thousands of documents kept at Cambridge, wandered the Galapagos trying to grasp what Darwin saw and thought.

None of us have or could have come close to this kind of devotion to Darwin. Yet, I imagine we all would like to think of ourselves as Darwinophiles. I do. I admire how his life developed, how fortunate he was to have sailed on HMS *Beagle*, and how dedicated he was to writing it all down. All paleontologists must envy his adventures in the field and his seemingly relaxed life at Down House recalling and writing about them. I've had the good fortune to have traveled and worked in most of the places he too explored, although no method was involved and most of the places I went were for entirely different reasons. It is because Darwin went so many places that any of us have a chance to imitate him. Darwin did have a remarkable time on the *Beagle*.

Darwin wrote 17 books, many articles, and thousands of letters to his correspondents--too many for a working paleontologist to digest. Indeed, today as I sat listening to speaker after speaker at our Darwin celebration talk about the great man's influence or accomplishments in one field of biology or another (these were biologists, so they made no comment whatsoever on Darwin's contributions to geology), one eminent biologist leaned over and said "I haven't even read the *Origin*" and another admitted that he had not either. I was stunned—didn't they read all of Darwin's books? Or at least the *Origin of Species*, *Descent of Man* and the *Voyage of the Beagle*? The truth is that few of us have done that. But in those books are some neat thoughts.

So I celebrate Darwin's life today, with a selection of quotations from his books. They are not the best but they are pertinent to paleontologists and inspiring to me. Probably thousands more could have been listed, but these are my choice today:

Darwin, philosopher of science

False facts are highly injurious to the progress of science, for they often endure long; but false views, if supported by some evidence, do little harm, for every one takes a salutary pleasure in proving their falseness; and when this is done, one path towards error is closed and the road to truth is often at the same time opened. Descent of Man.

As a teacher, this is my favorite Darwin statement. While he wrote many other important ones, this one neatly and succinctly describes how science works or should work. Hypotheses proposed, proven false and rejected. No one should be afraid to propose a well-developed idea supported by some facts, but they should be prepared to have it rejected as more data become available developed by competing scientists. If this happens to you, you should be proud that your door was closed and a new road opened. Remind your critics that Darwin suggested you do it just that way. This is the way science works best.

Darwin, paleoecologist

We here see at the bottom of the cliffs, beds containing sharks' teeth and sea-shells of extinct species, passing above into an indurated marl, and from that into the red clayey earth of the Pampas, with its calcareous concretions and the bones of terrestrial quadrupeds. This vertical section clearly tells us of a large bay of pure saltwater, gradually encroached on, and at last converted into the bed of a muddy estuary, into which floating carcasses were swept. The Voyage of the Beagle.

Darwin's eye saw not just the present, but also the past quite clearly. This is not unique or a special sign that he was a genius. Many budding paleontologists do the same, and we hone that capability into our hypotheses and papers. It's comforting to see that Darwin did it before us, putting one observation after another into place to see the whole ancient picture. Standard stuff now days among us. As usual, Darwin set a precedent.

Darwin, paleobiogeographer

The existence in South America of a fossil horse, of the mastodon, possibly of an elephant, and of a hollow-horned ruminant . . . are highly interesting facts with respect to the geographical distribution of animals. At the present time, if we divide America, not by the Isthmus of Panama, but by the southern part of Mexico] in lat. 20 degs., where the great table-land presents an obstacle to the migration of species, by affecting the climate, and by

forming, with the exception of some valleys and of a fringe of low land on the coast, a broad barrier; we shall then have the two zoological provinces of North and South America strongly contrasted with each other. The Voyage of the Beagle.

Darwin was always thinking, always trying to paint the big picture while not ignoring the smallest detail. Of course he never went to Panama or Mexico and his impressions of these places came from the literature he read. On the *Beagle* he and Capt. Fitzroy were well prepared with a small library of critical books by naturalists who had visited other places and by practitioners of the larger sciences—Charles Lyell's great volumes on geology were on board too. Darwin, in spite of his persistent seasickness, or maybe because of it, read them too.

Darwin, stargazer

At last I am certainly in the Southern Hemisphere, & whilst enjoying the cool air of the evening I can gaze at the Southern Cross, Magellan's cloud & the great crown of the South. In August quietly wandering about Wales; in February in a different hemisphere; nothing ever in this life ought to surprise me. Diary.

Not a remarkable quote or even one describing an unfamiliar sight for paleontologists, it does remind me of the differences between his time and ours. Darwin had looked skyward at night as most people of his time likely did while on excursions or even at home. Most paleontologists can joyfully relate well to Darwin in this matter as we lounge around campfires in the field, but the majority of modern people have never truly seen the night sky at its finest as did Darwin or we. They are stuck in big, well-lit cities, mostly watching television, and never venturing into the mountains, onto the deserts or out to sea where they would even stand a chance of seeing all those millions of stars and star formations. Whenever I tell a group of people or a class of students about the sky I saw at night on some outcrop here or there, I see deadness in their eyes—they have no idea what I am talking about. Nor commonly do they care. We could have talked to Darwin about so many things that

the rest of the people could not. We are closer to him than many of us imagine.

Darwin, sedimentologist

No one doubts that our world at one time consisted of crystalline rocks, and that it is to their disintegration through the action of air, water, changes of temperature, rivers, waves of the sea, earthquakes and volcanic outbursts, that we owe our sedimentary formations. These after being consolidated and sometimes recrystallized, have often been again disintegrated. The Formation of Vegetable Mould Through the Action of Worms

Darwin understood the rock cycle well, and made observations on it wherever he went. He had many examples of sedimentary processes from his observations on the *Beagle*.

Darwin, reef geologist

. . . it may be asserted that there is not one point of essential difference between encircling barrier-reefs and atolls: the latter enclose a simple sheet of water, the former encircle an expanse with one or more islands rising from it. I was much struck with this fact, when viewing, from the heights of Tahiti, the distant island of Eimeo standing within smooth water, and encircled by a ring of snow-white breakers. Remove the central land, and an annular reef like that of an atoll in an early stage of its formation is left; remove it from Bolabola, and there remains a circle of linear coral-islets, crowned with tall cocoa-nut trees, like one of the many atolls scattered over the Pacific and Indian



The picture frame. Darwin's picture frame (the barrier reef with breakers in background), marginal paper (the lagoon) and the drawing (Moorea) on the northwest side of the island.

Oceans. The Structure and Distribution of Coral Reefs

and

The view was striking: it may aptly be compared to a framed engraving, where the frame represents the breakers, the marginal paper the smooth lagoon, and the drawing the island itself. The Voyage of the Beagle.

Darwin climbed Tahiti from Matavai Bay, the usual British anchorage where *Beagle* lay, and saw Moorea, then known as Eimeo, some 25 km distant. This view of Moorea, which he compared to a picture in a frame, together with his observations of the other Society Islands, especially Bora Bora (Bolabola) as recounted above, came together to confirm his ideas about the formation of atolls. His description, again was perfect, and his conclusions well drawn. Every coral island whether low or high that he encountered he put into his own grand picture of the process of fringing, barrier and atoll reef formation. Now every elementary geology, biology or oceanography text has Darwin's picture of that process in living color. Paleontologists have hugely benefited from his atoll theory ever since, regaling classes with stories of sinking mountains, giant clams, bleaching corals, and the pending demise of reefs altogether at human hands. I'd like Darwin's opinion on that!



Darwin, describing the land iguana of the Galapagos, concluded that "they are ugly animals" with a "singularly stupid appearance" but that "when cooked, yield a white meat." He apparently did not like the idea of eating one of these because he thought that only certain people could indeed eat one.

Darwin, on food

Like their brothers the sea-kind, they are ugly animals, of a yellowish orange beneath, and of a brownish red colour above: from their low facial angle they have a singularly stupid appearance. . . . These lizards, when cooked, yield a white meat, which is liked by those whose stomachs soar above all prejudices. The Voyage of the Beagle

Like some paleontologists and geologists I have known who tell entertaining stories of catching and roasting snakes (especially rattlesnakes) in the desert, Darwin lived off the land and sea along with the crew of his ship. In the course of victualizing the *Beagle*, many unusual animals were eaten that Darwin never tasted in England. Not only did Darwin and the crew eat iguanas, but also tortoises, various fish from the streams and sea, tropical plants unlike any they had seen elsewhere, and even some invertebrates, giant clams in particular. Darwin was often pained at the thought of removing such huge numbers of animals (especially the giant tortoises of the Galapagos) merely for food, for he foresaw their possible extinction.

Darwin, systematist

Nor shall I here discuss the various definitions which have been given of the term species. No one definition has satisfied all naturalists; yet every naturalist knows vaguely what he means when he speaks of a species. Origin of Species, 6th Edition.

Judging from what I just sat through at our Darwin celebration today, not much has changed in a century and a half. Our speakers tonight went on about what species were until we had a long list. Darwin would have been amused, had he lived to 199 years. He would have been intrigued as well because the idea of what a species is or should be is a fundamental issue in biology and paleontology, and it is not easily resolved. We argue about it all the time, sometimes raising our voices, so it must be very important indeed. If Darwin was not so certain, then we had better be careful too!

Darwin, taphonomist

The accumulation of each great fossiliferous formation will be recognised as having depended on an unusual

occurrence of favourable circumstances. Origin of Species, 6th edition.

Darwin was aware, as some paleontologists today are not, that fossilization requires special conditions that may affect our interpretations in significant ways. His view came from his knowledge and observations of not just the geological occurrences of fossils but also of how animals and plants lived and died today. Influenced in so many ways by Charles Lyell, his uniformitarian method is not surprising. We still do it this way today.

Darwin, bioturbationist

In the year 1837, a short paper was read by me before the Geological Society of London, {2} "On the Formation of Mould," in which it was shown that small fragments of burnt marl, cinders, &c., which had been thickly strewed over the surface of several meadows, were found after a few years lying at the depth of some inches beneath the turf, but still forming a layer. This apparent sinking of superficial bodies is due, as was first suggested to me by Mr. Wedgwood of Maer Hall in Staffordshire, to the large quantity of fine earth continually brought up to the surface by worms in the form of castings. These castings are sooner or later spread out and cover up any object left on the surface. The Formation of Vegetable Mould Through the Action of Worms

and

The plough is one of the most ancient and most valuable of man's inventions; but long before he existed the land was in fact regularly ploughed, and still continues to be thus ploughed by earth-worms. 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. The Formation of Vegetable Mould Through the Action of Worms

Sometimes considered an unusual side step for Darwin, his book on *Vegetable Mould and Worms* is a class in bioturbation. He carefully brought together his, his own sons' and other's observations and measurements to conclude that worms had a huge effect on the landscape, at the same time noting that other forces contributed to the diminution or addition of the worms' efforts. Worms covered up flint flakes, rocks, building stones and even entire buildings with their castings fairly quickly depending on the soil type and conditions. This process was enhanced by the subsidence caused by the worms working below the

objects. Truly a textbook on bioturbation that with little creativity can be used to demonstrate marine processes as well. Use it in your classes. The hypotheses, facts, and data tables are all there even for lab analysis.

Darwin, the micropaleontologist

It is not an insuperable difficulty that Foraminifera have not . . . progressed in organization since even the Laurentian epoch; for some organisms would have to remain fitted for simple conditions of life, and what could be better fitted for this end than these lowly organized Protozoa. Origin, 6th Edition.

Wouldn't you just know it, when Darwin was wrong, he chose my organism to be wrong about. This quote shows that Darwin was human too. He got it wrong. Foraminifera, of course, have "progressed" indeed in evolution, just like every other group, and that progression is easily grasped now. In his day, foraminifera were less well known, but even then their overall diversity and a good portion of their geologic history was known, at least among the French where d'Orbigny had described and documented so many of them. But in England, British foram workers, particularly Darwin's good colleague William Carpenter, did not believe the French. To Darwin, the British view made sense—protozoans did seem to be simpler than other organisms and therefore why should they evolve?. But he was influenced by his friends, perhaps not the best way to proceed. Had he had the time, or looked at forams instead of worms, he surely would have realized his mistake.

Charles Darwin was a great naturalist, geologist and biologist. His work has endured long and still forms the basis of much new research. The late Dan Axelrod, a paleobotanist who often followed the Darwinian method, used to tell us that if we needed a research project, just read Darwin and expand on some problem he had identified, for Darwin had seen it all and knew what was important and what was merely trivial. Not bad advice, especially when combined with modern approaches to our science.

In the coming Darwin-fest next year, let's be sure to include his non-biological contributions, for sometimes they get lost among all the good biological ones he left us. Start planning for this celebration now. Perhaps we can have a world-wide on-line party in his honor. We owe him a great deal.

REFERENCES

Darwin references from which quotations were extracted are listed below. Note that page numbers are not given for the quotations because these numbers vary from original to reprints of Darwin's works. You may or may not have access to the original material, but everyone using nearly any language can read Darwin. Most of Darwin's writings are now available on line. Just search in Ask.com or another search engine for "Darwin books" or the title of a particular one, and you will find a choice of sites.

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