

Teaching Darwin

***The Annotated Origin: A Facsimile of the First Edition of On the Origin of Species*, by James T. Costa. Cambridge, Massachusetts: Harvard University Press, 2009, pp. ix+537, H/b \$35.00**

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So, you think you know Darwin pretty well do you? Well consider writing a book about his revolutionary ideas that would be a paragraph-by-paragraph simplification of his thoughts as expressed in *Origin of Species*. You would probably come to the conclusion, like me, that it would be a monumental task which could take a good portion of a life. James T. Costa has done just that in his *Annotated Origin*, without apparently undergoing undue aging during the process. He makes the task look easy because his—what is essentially a translation—reads so very crisply. Darwin was of course a superb writer, but while his teachings of the mechanisms of evolution are marked by elegance and therefore also simplicity, the writing is not crisp. So, Costa has taken us by the hand to lead us on an adventure of learning about evolution.

One of the beauties of this finely-crafted tour of Darwin's *Origin* is that you can wander through it at will and still find a firmly-connected story of biology. I started at the back with *Biographical Notes* and there happened upon a brief and informative bio of Louis Agassiz, having heard that, meticulous scientist though he was (he founded the Harvard Museum of Comparative Zoology), he did not take kindly to Darwin's ideas on evolution. So, that lesson took me to Asa Gray—botanist and early ardent supporter of Darwin's ideas and a colleague of Agassiz at the American Academy of Arts and Sciences—that then led me to Cuvier and Lamarck as a history lesson, then finally to Thomas Huxley—"Darwin's bulldog." I will let you cogitate on the links between these great scientists, and I

could have gone on and perhaps explored all of the *Notes*—connection after connection, but time pressed me on to Darwin himself. Imagine assigning to your 10th grade class—after teaching about Darwin's ideas—a "chore," as students might see it, of reading about and telling a connected story between three evolution-related scientists and Darwin from this section of the book. I believe the students would get fairly hooked on the adventure of science that they would experience trying to do their choresome homework. And that is the beauty of this book—getting hooked.

The introduction of the volume leads us on "The Road to the Origin" where we learn of the almost accidental way that Darwin came to be the naturalist on the Beagle. It was a case of the prepared *curious* mind meeting the once-in-a-lifetime chance to discover a great idea. Teachers would do well to note to their students this example of the crucial importance that curiosity and preparation play in moving creatively through life. We are introduced here to Darwin's insights during the voyage, his long investigation of material evidence following the voyage, and his shock at discovering after so meticulous and laborious a research effort that Alfred Russel Wallace had already published (1855) his own theories (and Darwin's, 1859) on the mechanism of introduction of new species.

Costa now takes us by his gentle and firm hand into *Origin*. We learn at first the difference between his theory and others like Lamarck's—Darwin's common descent with its tree-like branches versus Lamarck's linear change. In a sense, it is that simple, and we almost have a "eureka moment." When you read the original Darwin, the beauty of his prose makes you almost ignore his logic. Costa crisply navigates the currents of Darwin here, as he does steadily throughout his book.

At the head of each chapter we get an overview in the briefest of space of what we are in for, and instead of

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intimidation (the common perception of Darwin's writing), we get clarity through brevity. Here is part of Costa's introduction to Chapter 1 of *Origin* (p. 7): "Darwin's main objective in this chapter is to argue for a genealogical pattern of relationship among domesticated varieties of a given group of plants or animals, and against the view that such varieties simply represent a like number of wild ancestors." We immediately are put at ease...maybe we students really can read, understand, and enjoy "hard" science.

And to prove it, Costa quickly draws our attention to this statement from Darwin (p.12): "Any variation which is not inherited is unimportant for us." Costa, on that sentence: "This sentence is important. Darwin may not know the actual basis for variations, but he realizes...that any variation that cannot be passed on to offspring cannot be selected for or against." I perhaps might have added that this sentence demonstrates to Darwin's readers that evolution is materialistic—that all traits moving through generations must be encoded on molecules, thereby taking popular romantic, emotional "magic" away from mechanisms of evolution.

Costa is good at leading questions, too, for example, this one (p. 13) on "blending inheritance:" "If traits are blended in the reproductive process each generation, how can an earlier configuration re-emerge?" We wonder what the answer is and find ourselves wanting to figure it out, i.e., thinking without being asked to. Nice teaching. Students could spend a whole class—nay, week—discussing such observations especially using themselves as examples.

At the entrance to Chapter II (p. 44), Costa is almost in danger of having us skip it because his introductory description of "Variation Under Nature" (as opposed to "...Under Domestication," Chapter I) so clearly summarizes it in about ten lines. We almost say, "that is it then, what else is there?" But no, we want to know more, and with Costa's guidance we smoothly navigate the chapter and soon enter the jaws of death, a "Struggle for Existence," the topic of Chapter III. We are prepared, for Costa decodes Darwin's "groups subordinate to groups" by hinting at a mechanism that creates "groups"—which is the title of our new chapter.

Darwin instructs us early on in Chapter III (p. 61) that "I have called this principle, by which each slight variation, if useful, is preserved, by the term of Natural Selection..." Costa gives us the history (again with his characteristic brevity) of the term and Darwin's critique of it, while reminding us that Wallace is "out there." Costa relates that Wallace preferred the term of Herbert Spencer's—"survival of the fittest." Trusting naturally to our sure-footed guide, we go to "Biographical Notes" and find—to our slight disappointment—no mention of H. Spencer, but we are reconciled by his concise biography of Wallace, which leads us to titles of two excellent travel adventures in the

name of evolution—Wallace's *Travels on the Amazon* and *The Malay Archipelago*. This is another example of the seamless way that Costa connects us to the life, times, and science that surrounded the era of *Origin*.

Notes throughout Chapter III steadily guide us through Darwin's teachings of the principles of evolution by natural selection. Still, as thorough as our guide is, I think Costa may occasionally miss an important Darwinian thought train that could use a good "note." On page 66, Darwin, in discussing the connection of exponential population growth to natural selection states, "...It is most necessary...never to forget that every single organic being around us may be said to be *striving* (italics mine) to the utmost to increase in numbers..." The phrase implies "purpose," and natural selection is piteously purposeless—a point which students can never quite accept given our cultural states of mind. We all strive, after all, for wealth and happiness do we not?

Ecology was always on Darwin's mind, and he may be thought of as perhaps the most important influence in directing biology-thinking within the context of environmental boundaries. Costa nicely reminds us of Darwin's ecological mind on p. 73 where Darwin discusses "forces so nicely balanced, that the face of nature remains uniform for long periods of time..." to which Costa notes, "This beautiful sentence captures the essence of the ecological web, as well as the struggle for existence." They both reminded me of Dobzhansky's dictum that, "nothing in biology makes sense except in the light of evolution," which seems to beg biology departments to finally figure out to teach evolution alongside of ecology first and all the rest later.

Chapter IV, "Natural Selection," ties the story of evolution together. There is no part of it that is not important in the understanding of the mechanism of evolution by natural selection. Costa notes, in the first paragraphs of the chapter, the continuous connection that Darwin reinforces between biology and the forces of nature—the ecology of life. The elegant picture of this connection is found in Darwin's famous tree (Fig. 1)—the only diagram in *Origin*. Costa superbly teaches us how Darwin here (p. 116) brings together phenomena of "...divergence of character, natural selection, and extinction into a unitary system." He then provides a simple description of the figure condensing Darwin's 2+ pages in *Origin* to a few teachful paragraphs such as this note (p. 119) which would enlighten students from elementary school to college:

Recall that species A at the bottom left of the diagram is a 'common widely diffused, and varying species, belonging to a genus large in its own country.' Implicitly, B, C, and D are not. These are driven to extinction, literally overtopped by the burgeoning tree that is A's descendants. Recalling that horizontal

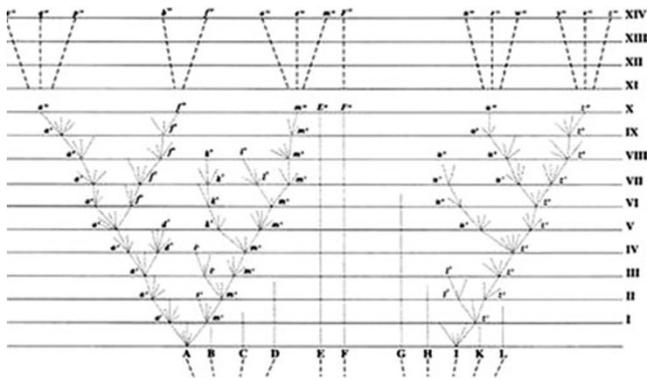


Fig. 1 Darwin's tree from *The Origin of Species*

position indicates a certain niche in the economy of nature, we can see that the positions of B–D become co-opted by the group in lineage m; a perpendicular line dropped from m^1 – m^6 would intersect the bottom horizontal line more or less at their positions. Extinction, then, is a central feature of Darwin's model.

Darwin's famous "Summary" of Chapter IV teaches so well that, had we been too lazy as students to read our assignments in *Origin*, we could read this section and gain a good solid summary of the story. Here Costa provides an example of Darwin's new-idea-thinking applied to his own ideas, noting that Darwin considered the term "coral of life"

a more accurate description of evolution by natural selection than a tree analogy. Costa notes (p. 130) how this idea has moved forward into a new mechanism of evolution—"pattern pluralism"—the idea that different patterns of evolutionary relationship hold for different taxa and at different temporal scales...."

And so it goes throughout the 537 pages of the book. Costa teaches clearly, interestingly and relentlessly to the end—always clarifying and simplifying, never confusingly. I have concentrated for this review on the first four chapters of Darwin because that is the core part of *Origin* I teach my students, but lest you doubt that the rest of the book is equally instructive, then pick an evolutionary topic, track it down, and see what is learned. For example, I have an interest—related to ecology—in geology, so I wandered over to Chapter 10 (p. 313) wherein Darwin describes his observations leading to his theories "On the Geological Succession of Organic Beings." Costa dissects these and describes to the reader—his students—how Darwin uses evidence to make a logical scientific story. Both authors are teaching us how science works, which is what this illuminating book is all about.

I suggest making this book a required reference source in evolution classes, with several copies available for student use. Students could be put to good use as teachers in class by reporting their stories from topics in *Origin* that interest them, all made accessible by this finely crafted textbook.