

RINGING THE BELL FOR DARWIN

by

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[I started writing this in early 2009—the sesquicentennial of the publication (in 1859) of Charles Darwin’s *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. (When the sixth edition was published, in 1873, the title was shortened to *The Origin of Species*.) However, after completing Chapter 9, I began to lose interest in the project, and stopped writing. I had planned to write a Chapter 10 (“Justifying My ‘Translation’”) and Chapter 11 (“A Critique of Darwin”), to be followed by a Part Three consisting of two chapters (Chapter 12, “Natural Selection’s Irrelevance” and Chapter 13, “Where to Next?”). By the time that I had completed Chapter 9, though, I was developing other interests, and ended the Darwin project. Given the possibility that some may find my presentation of interest, even in its incomplete state, and given also that I know that I will never come back to this subject, I thought that I should make this presentation available to the public.]

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Foreword

As we enter these twilight years of the Age of Darwin, “a decent respect to the opinions of [humankind] . . . requires that [we] . . . should declare the causes which impel . . .” us to the abandon Darwin. Before we can specify *why* we are taking leave of [Charles Darwin](#) [1809 – 1882], however, it is essential that we specify *that which* we are quitting. An obvious point, but one too often ignored—and a principle that is in especial need of application in the case of Darwin’s (alleged) “theory” of natural selection, given the confusion surrounding the term (a matter given attention in Chapter 1 in the context of a court case).

Actually, what Darwin referred to as a theory—“my theory,” indeed, in many places¹—is better termed a model. A cryptic clue to this fact is embedded in William Irvine’s brilliant point that “Darwin had not so much proved that natural selection *does* occur as that it *must* occur.”² (emphasis added) At any rate, in Chapter 5 I distinguish between “theory” and “model,” and place Darwin’s work in the second category. Thereby, however, placing Darwin in rather good company (unbeknownst to Darwin, evidently)—that of pioneering modeler [Johan Heinrich von Thünen](#).³

Usually Darwin’s modeling work in [Origin](#)⁴ has been equated with “natural selection,” but herein I think of it as tripartite (see Chapter 7)—two macro parts and one micro one. The natural selection model (the micro component) is, of course, the dominant component of this model by far. Still, Darwin’s model *does* contain three parts, and fairness demands that one recognize all three parts (what I refer to as the Comprehensive Model). However, because the macro parts

¹ As if [Alfred Russel Wallace](#) [1823 – 1913] had not arrived at virtually the same “theory” at the same time!

² *Apes, Angels, and Victorians: Darwin, Huxley, and Evolution*. With new Introduction by Sir Julian Huxley. New York: Time Incorporated, 1963, p. 129. First published by McGraw-Hill Book Company, Inc., 1955.

³ Several decades prior to *Origin*’s publication, *Der isolierte Staat* (first published in 1826), by German Johann Heinrich von Thünen [1780-1850], had introduced a new research procedure, that of model building and testing, from which Darwin could have gleaned valuable ideas. Thünen had begun his work by constructing a simplified deductive model (pertaining to agricultural activity viewed geographically), but then developed (“complexified”) the model by progressively introducing more realistic assumptions. Thünen’s goal here was to arrive at a version of the model which could “predict” a real-world situation as accurately as possible—thereby providing an adequate explanation of that situation. , *Der isolierte Staat*, 1826. Translated by Carla M. Wartenberg from an abridged version of the second German edition as *The Isolated State*. Edited, and with Introduction, by Peter Hall. Oxford, UK: Pergamon Press, 1966. On the internet see: <http://cepa.newschool.edu/het/profiles/thunen.htm>.

⁴ When the book was published in 1859, its full title was *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. For the sixth edition, however, published in 1872 (the last one published during Darwin’s lifetime), the title was simplified to *The Origin of Species*. For convenience, herein I usually refer to the book as *Origin*.

require little attention, they are disposed of in the same chapter (Chapter 7) in which they are presented.

I might add here that the previous chapter (6) is related to Chapter 7 in that it presents a speculative scenario (or “conjectural history”) regarding how Darwin arrived at his comprehensive model. What excuses me for so doing is that evolutionary biologists are continually using scenarios within which natural selection is given a role; *that* fact gives me a right to present my own scenario—but dealing with Darwin’s *modeling efforts* rather than using natural selection as an explanatory factor.

This is the 150th anniversary of the publication (on November 24, 1859) of *Origin*, and the 200th anniversary of the birth (on February 12, 1809) of Darwin himself. Given that anniversaries should be times of celebration, why, then, am I intent on “spoiling the party”? It’s not because I am a contrarian, with a psychological need to call attention to myself. Rather, it’s because I have studied *Origin* and secondary literature regarding it for a number of years, as ideas have occurred to me relative to my reading I have written them down, and now I am putting them together into a book—which just happens to be highly critical of the Darwin of *Origin*. I suspect that two factors account for the sort of book I have written. First, like my hero, [Thorstein Veblen](#) [1857 – 1929], my mind seems to have an iconoclastic bent that influences my views on a large number of subjects, not just evolution. Second, in never having taken any coursework in Biology, I have never had drummed into my head that Darwin is a virtual deity. Rather, my coursework over the years has been primarily in History (American in particular), English, Geology, Geography (Location Theory especially), Sociology (Demography, Human Ecology), and Economics (Introductory Micro and Macro, Industrial, and Regional). The coursework with most relevance for the writing of this book, however, has been that in Location Theory and Regional Economics, for courses in those areas have disciplined my mind to think in rigorous (I hope!) logical terms.

It’s not personal psychological needs, then, that have motivated me to write this book. Rather, it’s simply because it is long past time to bid farewell to Darwin. One could argue, in fact, that Darwin’s comprehensive model and its various components has lacked empirical support since *its very publication*—a viewpoint that is unlikely to be a very popular one with evolutionists today! Let me explain myself here, however—and begin by declaring that by no means am I here denying *that* evolution has occurred; rather, I am questioning its *explanation*—a quite different matter (a matter, in fact, that has caused a tremendous amount of confusion, as I point out in Chapter 1).

The great eighteenth-century Swedish scientist Carolus [Linnaeus](#) (i.e., Carl von Linné [1707 – 1778], through his famous taxonomic work, can be thought of as laying the groundwork for the development of evolutionary ideas, because that work suggested that species were related not only in a *generic* sense, but a *genetic*⁵ sense as well: It suggested that simpler species had “given

⁵ This word was coined by [William Bateson](#) [1861 – 1926], the word “gene” having been coined in 1909 by [Wilhelm Johannsen](#) [1857 – 1927]. Bateson is also known for publicizing [Gregor Mendel’s](#) [1822 – 1884] 1866 paper on heredity, after it was rediscovered in 1900 by [Hugo de Vries](#) [1848 – 1935], [Carl Correns](#) [1864 – 1933], and [Erich von Tschermak](#) [1871 – 1962]. Interestingly, Correns had been a student of [Karl Wilhelm von Nägeli](#), a noted botanist with whom Mendel had corresponded.

rise” to more complex ones, so that potentially all currently-living species had a single common ancestor.⁶ Ironically, however, a sort of inference that seems obvious to us today was *not* in the eighteenth century—nor during much of the nineteenth century either. Linnaeus himself was a firm believer in the fixity of species, and so was Darwin until after his famous *HMS Beagle voyage* (of December 27, 1831 – October 2, 1836): Darwin first began to commit to writing (in a Notebook) his “transmutation” ideas in 1837.

The fact that species could be arranged in such a way that they seemingly formed a gradation seemed not only to provide evidence *that* (what today we would call) evolution had occurred, and in this respect Darwin was correct—as had been various other individuals before him, including his grandfather [Erasmus](#). Classifications, however, can be deceptive in what they may imply regarding the *time* factor. [Classifications](#) *seem* to suggest that the transition from one species to another has been a smooth, steady (and perhaps slow) process, but research over the past 40 years has concluded that by no means has that been the case. Neither Darwin, nor others of his time, could have known this, of course—thus it would be foolish (no insane!) to criticize Darwin for not knowing what, at the time, could *not* have been known. Thus, my point here is not to offer a *criticism* of Darwin (which would be absurd) but, rather, to assert that it is incumbent upon us moderns to “read the handwriting on the wall” and recognize that it is high time that Darwin’s explanatory ideas be discarded in favor of ones that have some measure of explanatory merit.

Insofar as herein I am critical of Darwin’s natural selection explanation, it is important to keep in mind that “natural selection” is a slippery term in the evolutionary literature: It is not given a clear, consistent meaning; indeed, the term even lacks a consistent meaning in *Origin*! When I use the term “natural selection” herein, I am giving it a specific meaning—one that I believe “translates” the meaning that Darwin gave the term in his *definitions*, if not his *usages*. If one comes to this book with a meaning for “natural selection” that differs from the one that I give it, one may very well object to my dismissal of natural selection—but one is thereby being unfair in doing so.

I should perhaps begin here by making a few comments on *Origin*, and the particular imprints to which I will be making reference. *Origin*⁷ went through six editions during Darwin’s lifetime, and I will be referring specifically to the second⁸ and sixth⁹ editions. The second edition was published just a few weeks after the first (published on November 24, 1859), in January 1860; the sixth edition was published in 1872. I primarily use the second edition because it was simply a “corrected” version of the first, thus should be thought of as best expressing Darwin’s thinking upon his initial publication of the book. I use the sixth edition primarily because it uses the

⁶ [D’Arcy Wentworth Thompson’s](#) [1860 – 1948] later work “on growth and form” provided analogous (but more solid) evidence to a later generation.

⁸ The particular imprint that I have used: Charles Darwin, *The Origin of Species*. Oxford, UK: Oxford University Press, 1996. Edited, and with Introduction, by Gillian Beer.

⁹ The particular imprint used: Charles Darwin, *The Origin of Species and The Descent of Man*. New York: The Modern Library, 1936 (which date does not appear in the book).

phrase “survival of the fittest”¹⁰—borrowed, with credit, from a work by [Herbert Spencer](#).¹¹ When citing (or alluding to) the second edition, I place the page number(s) being referred to in the text, rather than using a footnote. I use the same procedure for referencing the sixth edition, except that a “[6]” appears after the page number(s) cited. (I might add that some scholars believe that after the second edition, subsequent editions became progressively more muddled in their argumentation. So much for the evolution of book editions!)

As one reads through *Origin*, one finds that “natural selection” is defined in several places (e.g., 6, 52, 67 – 8), and related terms (e.g., “struggle for existence”) are also so defined. My focus here, however, will be on “natural selection” itself rather than related ones, so as to avoid confusion as much as possible.¹²

The passages that include a reference to natural selection are, however, somewhat odd, and it will be useful to point out some of these oddities before proceeding further.

First, in those passages that offer a definition of “natural selection,” those definitions are in agreement, but none of them makes reference to *that which* natural selection *explains*—what I will be referring to herein as natural selection’s [explanandum](#), to help add clarity to the presentation. Indeed, as one reads in the text, one discovers that the *explanandum* (like the comprehensive model itself) is tripartite rather than singular—those three components of the *explanandum* being, however, interrelated and forming an integral whole.

Second, not only do these three parts *not* occur in conjunction with discussions of the “theory” *per se*; the parts are scattered throughout the book, and one needs to be diligent in one’s search to discover them. It’s as if Darwin lacked a clear idea of just what his natural selection “theory” was designed to explain!—this giving us a reason for referring to the “theory” as a *model*, rather (as we shall see in Chapter 5).

Third, as one reads in *Origin*, one finds “natural selection” *used* frequently, and because Darwin’s *definitions* of natural selection are consistent one with another in meaning, one naturally expects that the meanings that one can infer from *passages* that *use* “natural selection” would give the term the same meaning to “natural selection” that Darwin gave the term in his *definitions*. Instead, one finds an inconsistency not only between the (a) *definition* meanings and the (b) *passage* meanings; one also finds considerable inconsistency *among* the various *passage* meanings. Indeed, I find *four* different meanings given to “natural selection” from a *scope* standpoint, and additional meanings at a more *specific* level (which matters I elaborate on in

¹⁰ Darwin first used this phrase in the fifth edition, published a decade after the first edition (1869).

¹¹ Spencer [1820-1903] had used the phrase “survival of the fittest” in his [Principles of Biology](#), a 2-volume work published in 1864, then 1867.

¹² For example, the oft-referred to passage on p. 53 that gives “struggle for existence” such a broad meaning as to render the term virtually meaningless is avoided for that very reason. Some seem to be attracted to that passage, however, because of that very fact: presumably they want to use the passage to buttress their own esoteric concept of the term.

Chapter 4). These facts mean that one is faced with a perplexing problem in determining *THE* meaning that should be attached to “natural selection” in *Origin*.

I did, however, come to a definite conclusion, and here is the reasoning process that I went through to solve this problem:

- Given that Darwin perceived “natural selection” as a theory (even *my* theory!, as he stated frequently)—and therefore having as its function to *explain* something (see Chapter 3)—and that one can also think of a [theory](#) (a) as a *mechanism* which (b) “produces” a certain definite outcome, these facts lead to the additional questions: (c) What is the mechanism that should be associated with natural selection? And (d) What *outcome* does that mechanism produce? That is, I assumed that (a) a certain mechanism along with (b) that which it *produces* (i.e., *explanandum*) should be thought of as forming an integral whole.
- Given that a given mechanism would be expected to produce one, and only one, output (generally)—but that the reverse would not necessarily be expected—what needed to be done first was to identify that outcome. As I stated earlier, I discovered, in reading *Origin*, that that outcome was tripartite in character.
- Having established what the theory (i.e., mechanism) was supposed to *explain*, the next task was to discover that mechanism which would *produce*—or, put another way, *explain* (or *predict*)—the change associated with the *explanandum*. This problem turned out not to have a straightforward solution, for I discovered three possibilities, not one.
- Reasoning that “natural selection” should not only have a single *explanandum* associated with it, but also a single “explaining” mechanism, the next problem, then, was selecting the appropriate mechanism from the three that I had discovered.
- As the phenomenon of (what I will be referring to as) “excess births” is (a) an integral part of his natural selection definitions, (b) that phenomenon is not necessarily associated with the other two mechanisms, and (c) is a concept that plays an important role in other parts of *Origin*, it seemed absolutely clear to me that the mechanism that Darwin associated with “natural selection” in his definitional passages of same should be accepted as *THE* mechanism that should be associated with the term. So that that mechanism, in conjunction with its *explanandum* should be understood as the *complete* meaning of “natural selection”—and *no other* meaning should be associated with the term-event. In Chapter 9 I present and discuss 11 selection mechanisms in addition to that associated with natural selection—and these are as “natural” as that associated with natural selection (!), but the term “natural selection” should be reserved for just the one mechanism—otherwise we will get trapped in a communication swamp.

There *is* a problem with this conclusion, however; it is that Darwin’s definitions of “natural selection” are all ridiculously short, and therefore subject to varying interpretations—something that *has*, in fact, occurred, as one might expect. However, I concluded that (a) if Darwin’s definitions were examined with a microscope, (b) the book itself were mined with the purpose of helping “flesh out” a more precise definition of “natural selection;” and, finally, (c) if rigorous

reasoning were used in this analytical process, a well-developed meaning for “Darwinian natural selection” could be established. I use Chapter 4 to address the topic of clarifying the meaning of “natural selection,” concluding that chapter with a presentation of my own “translation” of Darwin. I follow that chapter with one that approaches the clarification matter from a different perspective, and then use Chapter 6 to defend the particular “translation” that I had presented at the conclusion of Chapter 4.

The basic reason for pursuing this matter of clarification thoroughly is that it can result in making the meaning of Darwinian “natural selection” “crystal clear” (I hope!). In addition, however, by clarifying the meaning of “natural selection,” one is placed in a better position to critique the theory: It is impossible to critique meaningfully *anything* if its meaning is not clear: under such circumstances one simply “shoots at the moon” without any foreknowledge of whether or not one might hit one’s target.

A final point that I would like to make prior to indicating how the book is organized: I am reminded here of the statement by Napoleon, “You commit yourself, and then—you see.”¹³ One way of interpreting this statement is that if one engages in an effort to clarify something (such as Darwinian natural selection), one’s initial efforts likely will have problems that one will later detect (but only because one had made that *initial* effort). In seeing those problems one will, quite possibly, eventually be able to *solve* those problems (their recognition somehow being a cause of arriving at a solution—perhaps as one lets one’s unconscious work on them at night), and the arrival at *that* solution, in turn, will precipitate ideas as to problems with that which one has just clarified—enabling one to then write a critique. With one’s initial version of *that* critique At least the above describes the process that I have often experienced, not only in writing this book but with numerous previous writing exercises. This means that writing can be an extremely frustrating process, but be an extremely rewarding one as well.

In our specialized society most of us are employees, and are involved in but a small part of our company’s work. Our fathers, in contrast (mine was a carpenter who worked with but a partner most of his life), often had jobs that enabled them to begin a task, and then carry it through to completion. My dad could have the pride that came from being able to travel around the county (Waushara County, in south-central Wisconsin) and point to the houses, cottages, and even barns, that he and his partner had built over the years. I, on the other hand, work for a fairly large engineering (avionics) firm in Milwaukee, and participate in just the data management portion of my company’s work. Working on a book such as this one has enabled me to conceive a project *on my own*, and carry it through to completion. There is, thereby, a sense of satisfaction that comes from such an effort that makes the effort worthwhile—for me, if no one else. Given that fact, I have no regrets in having undertaken the effort.

As to the book’s organization:

Because I have observed so much confusion regarding, “theory,” “hypothesis,” “monotypic” (vs. “polytypic”) evolution, etc., I have decided to illustrate this point in my first chapter, by focusing on a particular court case, followed by an article in a semi-professional magazine (*National*

¹³ Quoted (as an epigraph) in William Appleman Williams, *The Contours of American History*. Chicago: Quadrangle Paperbacks, 1966, p. vi. Originally published by World Publishing Company, 1961.

Geographic). Chapter 2 then discusses some general matters that pertain more to the subject of evolution than to Darwin; the intent of this chapter is to simply provide some general background to the subject matter of the book. Part One in general is devoted to preliminaries, hence its title.

Some methodological matters are then the focus of Chapters 3 – 5. The data matrix is a format for collecting and presenting data, and as a format is very helpful for *thinking* about data; therefore, I thought that a discussion of the data matrix at the very beginning of my book (Chapter 3) would be useful for understanding certain passages in the book.

A central concept in discussions of evolution is that of *variation*: Darwin’s natural selection model, for example, uses as a starting point the assumption that individuals of a given species vary in their characteristics, introduces some additional assumptions which then—with the initial assumption of individual variation—“produce” additional variation. The difference here is that the initial variation is assumed to exist at a certain *point in time*; and the addition of the additional assumptions gives *dynamism* to the model, so that it now produces variation (i.e., change) over time. In Chapter 4 I discuss variation from four perspectives, concluding the chapter with a summary of Darwin’s references to variation. The earlier discussion of the data matrix provides essential background for that discussion.

The purpose of a theory or model is to *explain*. The irony here is that a theory or model explains (typically) in a *deterministic* way (i.e., it consists of statements regarding causes thought to have explanatory power), but it is something that one *chooses* to create! That is, the beginning point is a desire on the part of someone to explain something, and the result may be the creation of a theory or model that serves that purpose. The theory/model created may be very simple or, rather, very elaborate; but what makes it a theory/model is that it was *designed* for a specific purpose, that of satisfying a desire to know why something is as it is (or was). *How* does a theory/model explain? How does a theory differ from a model? How does a theory differ from a hypothesis? What is an *explanandum*? What, in contrast, is an *explanans*? These are the questions addressed in Chapter 5.

The chapters up to Chapter 6 provide preliminary information of varying sorts. Their presence is there to help understand that which is presented in the five chapters that comprise Part Two. I begin this part with a brief chapter (6) that indicates my “theory”—in the form of a scenario—regarding how I believe Darwin arrived at his comprehensive theory; that is, the experiences he had, and thought processes he went through, that resulted in the creation of his model.¹⁴ In Chapter 7—also rather brief—I then present the theory proper, followed by some brief commentary on the two “macro” portions of that comprehensive theory.

The much lengthier Chapter 8 then represents a major effort at clarification of “natural selection.” I begin by pointing out that although I am able to derive a single, clear meaning for “natural selection” from *Origin*, the fact of the matter is that one of the reasons that book can be difficult to comprehend is that, from a scope standpoint, “natural selection” is given four

¹⁴ The fact that Wallace arrived at virtually the same model raises the question: Does this scenario also apply to Wallace? If not, what would be a comparable scenario for him? I leave both of these questions unanswered here.

different meanings in *Origin*. I then quote the definition of “natural selection” that Darwin gave in *Origin*, and comment on its “struggle for existence” component and other matters. This presentation is then followed by three “translations” of Darwin, one by sociobiologist David P. [Barash](#), one by noted biologist, the late [Ernst Mayr](#), and the final one by myself.

Because the natural selection model is just one of the selection models (all of them natural!) that operates in the real-world, I believe it helpful to identify and discuss those other ones to help reduce confusion, while also establishing *boundaries* for the natural selection model: Expanding the meaning of “natural selection” by indicating how it relates to other selection models. This is done in Chapter 9.

Because several aspects of my “translation” in Chapter 8 may demand justification, I provide a rationale for each of those elements in Chapter 10. In doing so, I hope that I have not missed anything. Then, in Chapter 11 I offer a critique of Darwin, focusing on his “micro” theory (i.e., natural selection), having already critiqued the “macro” portion in Chapter 7.

Part Three offers some concluding remarks, on two fronts. In Chapter 12 I point out, first, why Darwinian natural selection lacks relevance for explaining human evolution (while making some brief comments on some theories/models that would seem to *have* relevance in that regard), and also why that “theory” (especially in the form of the “law” of “the survival of the fittest”) provides no scientific basis for the “philosophy” of Social Darwinism.

Chapter 13 then returns to the subject of evolution proper, and identifies some of the theoretical work that has been occurring recently—from which may emerge a new theory, and a new Darwin. Personally, I can’t say that I am “waiting with bated breath” for a new theory to emerge, given that my dominant interests lie elsewhere than with evolutionary theory—or Biology. The sort of theory that *I* am looking for, however (and I am not looking that hard!), is one that explains the “punctuated equilibria” pattern discovered by [Niles Eldredge](#), first written about by him in 1971,¹⁵ and subsequently joined in other writing efforts by the late [Stephen Jay Gould](#).¹⁶

¹⁵ See (using the citation method recommended by Niles Eldredge) : Eldredge, N. 1971. The allopatric model and phylogeny in Paleozoic invertebrates. *Evolution* 25 (1): 156 – 167. The article is available at: <http://www.nileseldredge.com/NELE.htm> .

¹⁶ Several years ago I purchased a book by Eldredge, hoping that it would contain a “confession” regarding the irrelevance of natural selection for explaining his findings, but found none. Doesn’t he want to go against the Evolution Establishment (of which he is a part!)? Niles Eldredge, *Reinventing Darwin*. New York: John Wiley & Sons, Inc., 1995. Attempting to be a Harvard sophisticate (I guess), on p. 9 he states the following: “As time goes by, as lineages diversify (like manuscripts going their separate ways), and as evolutionary innovations and modifications (like typos) occur, a distinctive, layered history of modification accumulates—one that can readily read backward.” What have we learned here regarding *how* “lineages diversify”? Absolutely nothing! A phenomenon common in the evolutionary literature—within which glibness seems to have a special place of honor.

PART ONE: PRELIMINARIES

Chapter 1: Current Evolutionary Confusion

“A plague o’ both your houses!”

Mercutio, *Romeo and Juliet*, Act 3, Scene 1

In the autumn of 2001 officials of the Cobb County (Georgia) School District initiated the process of selecting new science textbooks for future use, and established a textbook adoption committee to make recommendations.¹⁷ The committee recommended a biology textbook authored by Kenneth Miller and Joseph Levine—which text was subsequently adopted by the School Board for use in high school biology classes (p. 6). When, however, local parents learned of the Board’s intention to upgrade instruction on evolution,¹⁸ and learned that the Board was in the process of adopting new science textbooks—ones containing discussions of evolution—some parents began expressing their concerns to Board members (p. 6). Although only three parents submitted official comment forms to the Board on this matter, a number of parents conveyed comments *orally* to Board members (p. 7). And “six-day biblical creationist” (p. 7) Marjorie Rogers obtained 2,300 signatures on a petition, presented to the School Board, that requested the Board to “clearly identify presumptions and theories and distinguish them from fact” (p. 7). The petition also requested the Board to place a statement at the beginning of texts that discussed the origin of life, one that would warn students that the material on evolution therein contained was of a theoretical, rather than factual, nature (p. 7).

This petition evidently had a decisive influence on the Board’s members, for on March 28, 2002, when the Board *unanimously* adopted the textbooks recommended by the administration, it stipulated that a sticker be affixed at the beginning of science textbooks within which evolution was treated, this sticker reading as follows (p. 8):

This textbook contains material on evolution. Evolution is a theory, not a fact, regarding the origin of living things. This material should be approached with an open mind, studied carefully, and critically considered.

Help in wording the language had been obtained from the School Board’s legal counsel, to ensure (they hoped) that it would be constitutional.

Dr. Roger W. (“Wes”) McCoy, one of the high school science teachers who had served on the textbook adoption committee, opposed affixing any sticker in science textbooks, but did propose two alternatives to the wording adopted by the Board. The administration expressed approval of one of these, having the following wording (p. 13):

¹⁷. *Order* by Clarence Cooper, United States District Judge, Civil Action No. 1 02-CV-2325-CC, *Selman v. Cobb County*, January 13, 2005, p. 5. The *Order* is 44 pages in length; text references (in parentheses) to page numbers here refer to pages in the *Order*.

¹⁸. To bring Cobb County into compliance with statewide curriculum requirements (p. 6).

This textbook contains material on evolution, a scientific theory, or explanation, for the nature and diversity of living things. Evolution is accepted by the majority of scientists, but questioned by some. All scientific theories should be approached with an open mind, studied carefully[,] and critically considered.

McCoy's objection to the sticker's wording was based—as he testified later—on his view that it involved a misuse of the word “theory,” thereby causing confusion—and therefore forcing him to devote an inordinate amount of time trying to help students distinguish between “fact” and “theory” (p. 16). At any rate, the Board basically ignored McCoy's alternate wording, because it had already voted on wording that its counsel had recommended as constitutional (p. 13).

Why did many Cobb County parents want a “warning label” placed in biology textbooks?¹⁹ Marjorie Rogers's complaint was that the books did not mention alternate theories, so that a warning label was in order (pp. 6, 7). (She later testified, however, that she was not happy with the sticker because it did not go far enough—e.g., it did not distinguish between macroevolution and microevolution; p. 13.) Some stated that the books failed to contain criticisms of evolution, so that students should be alerted to that omission (p. 7). Teresa Plenge opined that the sticker should not be viewed as a disclaimer but, rather, as a device to encourage students to think critically (p. 10). Betty Gray expressed the view that inclusion of the sticker would reassure the public that science classrooms would be tolerant places wherein diverse views could be expressed—not places where a certain uniformity of thought would be imposed (pp. 11, 12). Etc.

The controversy entered the courts, and the Court decided against the School Board, stating that the Board, in recommending use of the sticker—with its particular language—was siding with religiously-motivated critics of the textbooks adopted (p. 39). In fact, Judge Cooper went on to state that the Court was convinced that the sticker's primary effect went beyond *accommodation*, and actually *endorsed* religion (p. 41). “The School Board has effectively [and] improperly entangled itself with religion by appearing to take a position. Therefore, the Sticker must be removed from all of the textbooks into which it has been placed” (p. 42).

As my interest here is solely in the wording of the sticker, and comments on it by Cobb County residents, I make no further reference to the dispute as a legal matter. Rather, I offer comments on the sticker's wording, the alternate wording proposed by Dr. McCoy, and some of the parental statements. Let us begin with Dr. McCoy's alternately-worded (but unadopted) statement, and focus on his assertion that evolution is a “scientific theory, or explanation” Given this, the first fact to note regarding McCoy's statement is that it fails to distinguish between *monotypic evolution* and the *polytypic* variety. (The former term refers to biological change of a *given* species, to the extent that the species eventually “turns into” a new species; the latter term refers

¹⁹. One might also ask why parents did *not* want stickers placed in, e.g., American history textbooks, warning students that the text failed to discuss the numerous atrocities committed by, e.g., the U. S. military and CIA over the years! See, e.g., William Blum, *Killing Hope: U. S. Military and CIA Interventions Since World War II*. Monroe, ME: Common Courage Press, 2004. This is an update of the 1995 edition, which was a revised and expanded version of a book by Blum published in 1986. Eleven chapters of the book (along with the Introduction and an Appendix) are available on-line at www.killinghope.org.

to the emergence of several *new* species from a pre-existing one. Thus, the former type of evolution might be referred to as “linear,” the latter as “branching” evolution.)

McCoy's statement correctly equates “theory” and “explanation,”²⁰ but becomes questionable in its equation of “evolution” and “theory.” Let me explain²¹ why. In Chapter 5 below I present a fairly extended discussion of “explanation” *per se*, but at this point need to state only that in terms of the deductive model of explanation,²² an explanation can be thought of as consisting of *statements*, there being two types of statements associated with any given explanation. On the one hand is the statement to be explained; it is useful to refer to this using the technical term *explanandum*. On the other hand is a set of statements “above” the *explanandum* (collectively termed the *explanans*) which jointly “explain” the *explanandum*.²³ Under certain circumstances the *explanans* is referred to as a theory; but whether it is or not, the *explanans* is said to “explain” the *explanandum* by logically “producing” (or “predicting”) it. That is, the *explanandum* is (purportedly) deducible from the *explanans*, and *thereby* explained by the *explanans*.

Given the above (rather abbreviated) discussion of “explanation” as a concept, is it proper to refer to evolution as a theory? To simplify matters, let us assume that by “evolution” we mean specifically *monotypic* evolution. Now the first fact to note here is that “monotypic evolution” is a *name*—a name for a *process* of biological change. And this leads us to the observation that just because the *name* “monotypic evolution” exists, it does not follow from that fact that the *process* associated with that name actually occurs (or has occurred) in the real-world: one cannot call something into existence by simply creating a name for it!!—whether that name is “monotypic evolution,” “troll,” “unicorn, or whatever.”²⁴

In referring to evolution as a *theory*, McCoy might have meant that (monotypic) evolution is a process that most biologists *believe* occurs (and has occurred) in the real world; but if this is what he meant, he should have referred to (monotypic) evolution as a *hypothesis*. Perhaps, though, McCoy had something else in mind. Given that he stated that evolution is an explanation (or “scientific theory”) that has been offered to explain “the nature and diversity of living things,” he may have been thinking of (polytypic) evolution as a hypothesis (i.e., as not being firmly established empirically as “true”), but that because most biologists believed that, as a hypothesis, it was reasonably well-supported, it could be used to explain “the nature and

²⁰. However, whereas it is true that all theories are explanations, the converse is not necessarily. A discussion of explanation *per se* is presented in Chapter 5.

²¹. Here I use “explain” to mean *clarify*. Generally, however, the term “explain” is used herein to mean *account for*.

²². Sometimes referred to as the “covering law” model.

²³. One can think of the statements comprising the *explanans* as being all simple statements, a mixture of simple and compound statements, or one or more compound statements.

²⁴. Of relevance here is Chapter 4 (“Word Magic”) in (pp. 44 - 62) [Ernst Cassirer](#), *Language and Myth*. New York: Dover Publications, Inc., n.d. First published by Harper & Brothers in 1946. Translated by Susanne K. Langer.

diversity of living things.” If this is what he had in mind, he was correct, in this case, in referring to evolution as a *theory*: If polytypic evolution occurs, this enables us to understand (“explain”) “the nature and diversity of living things.” One might, though, regard such an explanation as vacuous, tautological—as merely involving playing with words, [Molière](#) style!

But if this is what McCoy *meant* in referring to evolution as a theory, is this how people would tend to *interpret* what McCoy said? I have my doubts. It seems to me that when people (especially, but not exclusively, “ordinary” people) use the term “evolution,” in the first place they fail to distinguish between monotypic and polytypic evolution—because they are too ill-informed on the subject to know that these two types of evolution exist (as terms/concepts, at any rate). Second, though, I suspect that when most people think of evolution, *implicitly* they are thinking of *polytypic* evolution, and are questioning *whether* such evolution *actually* occurs/has occurred in the real-world (or even the laboratory, for that matter). This means that they are not thinking of polytypic evolution as an *explanation*—even though they may use the term “theory” in conjunction with evolution. Rather, the way they are thinking of “evolution” is such that, in effect, they are thinking of it as an *explanandum*. An *explanandum*, true, that they think of as lacking in empirical support, but an *explanandum* nonetheless. And given that they (implicitly) think of (polytypic) evolution as an *explanandum*, they are *not* actually thinking of (polytypic) evolution in *theory* terms—as, in this case, an *explanation* of “the nature and diversity of living things.” Rather, they are thinking of evolution as a *process* for which it is pointless to create an *explanans* (i.e., theory, explanation)—for the process itself is something that is merely being *assumed*, rather than something firmly established through rigorous empirical research (as if they had any idea of *what* constitutes such research!).

When McCoy referred to evolution as a *theory*, then, he may have meant that scientists use the hypothesis that polytypic evolution occurs to explain “the nature and diversity of living things”—these scientists believing that the hypothesis in question is reasonably well-supported by empirical research. But if this is what he meant, the suggestion is that he does *not* think of polytypic evolution *itself* as playing the role of *explanandum* in an explanation; i.e., he is not interested in explaining *why* polytypic evolution occurs (assuming that it *does* occur), only *that* it occurs, and that *that* occurrence has certain implications. Given that I find the latter virtually impossible to believe (for I suspect that his classroom presentations include the discussion of *why* polytypic evolution occurs), I am at a loss to know precisely what McCoy meant in referring to evolution as a theory. Did he mean:

- Polytypic evolution occurs, and the fact that it occurs helps us explain certain phenomena?
- Polytypic evolution occurs, and there is a theory (with origins in the work of Charles Darwin) that explains how/why it occurs?
- Both of the above?

From the information given in the *Order* about Dr. McCoy’s views, I am unable to determine what McCoy meant in referring to evolution as a theory. It seems reasonable to conclude, however, that Dr. McCoy lacked a clear sense of what he meant in declaring that evolution is a

theory! There *is* a theory that purportedly explains both monotypic and polytypic evolution; but to refer to that theory as “evolution” is in error. Evolution *can* function as an explanation (thereby as a theory)—e.g., as an *explanation* for the nature and diversity of living things. However, usually “evolution” *per se* is thought of as a *hypothesis* (not a theory) *that* monotypic and/or polytypic evolution occur (a hypothesis that most scientists accept as rather well-established), and “theory of evolution” is thought of as the *explanation* for the occurrence of evolution. That is, “evolution” is thought of as an *explanandum*, and “theory of evolution” is thought of the explanation (*explanans*) offered for that *explanandum*.

When “ordinary” people refer to (polytypic) evolution as a theory, they seem to mean that they have doubts *that* polytypic evolution occurs (and has occurred); thus, they misuse the term “theory” in placing that label on evolution. They should, given the ideas that they have in mind, refer to (polytypic) evolution as a *hypothesis*, and go on to say that they don’t regard that hypothesis as well-supported by the extant evidence. Some ordinary people may be aware that there is a concept called “natural selection,” and may even know that biologists invoke “natural selection” to explain monotypic and polytypic evolution. But given that many ordinary people have doubts *that* polytypic occurs, it follows that they lack an interest in the (supposed) *theory* (natural selection) that biologists use to explain evolution—and therefore are totally ignorant regarding what that theory involves (except that they may associate “survival of the fittest” with the theory). Rather than believing that the diversity in species that exists resulted from the operation of natural mechanisms (i.e. a naturalistic explanation), many ordinary people believe that “the diversity of living things” is explained by the “fact” that a Being named “God” created all living things, end of story (an explanation that recognizes the existence of diversity, and explains it by asserting that God created all living things, and for whatever reason decided to create a great *number* of living things.). Ordinary people may agree that species can and do change biologically over time (being aware, e.g., that the purpose of *breeding* is to bring about monotypic change); what they tend to deny, however, is the “fact” that all existing species have a common ancestor. That is, they tend to deny *that* polytypic evolution has occurred.

Would a biologist—i.e., a scientist—agree with McCoy’s statement that evolution is a theory/explanation? I would like to think that a biologist, first, would insist that a distinction be made between monotypic evolution and polytypic evolution. Second, I would guess that most biologists aware of the distinction would assert that *both* sorts of evolution occur, and have occurred. Third, I would like to think that most biologists would label both types of evolution, not as theories, but as *descriptive generalizations* applicable to all species, for all time, these generalizations being “factual” in the sense that solid evidence exists in support of them; evidence that, if not *direct*, is *indirect*—having its basis in inferences drawn from, e.g., geological facts. Fourth, insofar as biologists regard the two types of evolution as descriptive generalizations which the reasonable person will accept as “true,” I suspect that biologists would assert that explanations (“theories,” if you will) *do* exist for both types of evolution—with many biologists contending that Darwinian natural selection (or some version of same) is the “mother” of all of those explanations. Given these comments, I would like to think that most biologists would criticize McCoy’s statement as, at best, ambiguous, confused.

In summary, it is by no means clear what Dr. McCoy meant in stating that evolution is a theory. Given this, it is not surprising that some would interpret the assertion as meaning that evolution

is *just* a theory; that although most biologists may *believe* that evolution takes place, they can offer no convincing evidence in support of that belief. Whether such people are right or wrong in their opinion regarding the “fact” of evolution, the fact of the matter is that they give “theory” a meaning different from that given the term by Dr. McCoy. They may *appear* to agree with Dr. McCoy, but the implied “just” in their version of “evolution is a theory” indicates that they are on a different “wave-length” than Dr. McCoy. Biologists might be more sympathetic to McCoy’s statement, but might add that it is ambiguous: (a) it fails to distinguish between monotypic evolution and polytypic evolution; (b) whereas it is true that either type of evolution (but perhaps especially the latter) can be thought of as having an explanatory role in certain contexts (so that in those contexts one can properly think of evolution *per se* as a theory), it is more common to think of evolution as an *explanandum* for which a theory needs to be created. An *explanandum*, in fact, for which a theory *has* been created, that theory having been given the name “natural selection,” and first discussed significantly by Charles Darwin (and subsequently refined by others).

Considering, next, the wording on the sticker actually adopted by the School Board, the key phrase that requires comment is “Evolution is a theory, not a fact” In commenting on this wording it will be helpful to begin by identifying types of statements. There are a number of different types of statements, but here it will be useful to distinguish between just three types:

- Particularistic: Statements that refer to particular individuals (defined broadly), places, times. For example: “John Smith, of Milwaukee, left for work at 6:55 A.M. on April 20, 2005.”
- Limited generalizations: Statements that make generalizations regarding *groups* of individuals, but are limited in *scope* in referring to just a *segment* of the population in question, and a particular point in (or period of) time. For example: “The average black household in Milwaukee earned (i.e., was *paid*—there *is* a difference!) \$4,132 less than the average white Milwaukee household in 2008.”
- Unlimited generalizations: Statements that are neither temporally nor spatially (or otherwise) limited. For example: The law of gravity.

Any one of the above types of statements can be either true or false—factual or non-factual. That is, just because someone makes a certain type of statement, it does not follow that that statement is factual—i.e., has empirical support. Indeed, many of the statements that one encounters—in reading, in conversing with others, in listening to the “news” on TV,²⁵ etc.—are of dubious “truth-value.” Those making statements are not necessarily trying to deceive others (with the exception of those making statements on behalf of a product—and politicians, of course!); the point, however, is that one must be cautious in accepting statements that one encounters at “face value.”

How are “theory” and “fact” related (if they are)? A “theory” is a species of explanation, and as such can be thought of (as I pointed out a few paragraphs back) as a set of statements from which

²⁵ As I edit this “book” in March of 2012, political advertisements especially come to mind!

some other statement (the *explanandum*) can be logically deduced. (See Chapter 5 for further discussion.) A given explanation (of this sort) can be termed an *explanans*, and the *explanandum* in question can be a particularistic statement, a limited generalization, or an unlimited generalization (the latter usually termed a “law” if well-established empirically). If the explanation is of a *law*, the *explanans* can be referred to as a *theory*. Occasionally, however, scientists use the term “theory” for explanations of the particular (e.g., the origin of the solar system), with such explanations understood, however, as having general applicability for solar systems *per se*).

Individual statements can be labeled as “true” or “false,” “factual” or “non-factual.” But is it proper to so label *theories*? Usually one does not label a theory as being “factual” or not; rather, a theory is said to be “acceptable” or not. What makes a theory “acceptable”? Several criteria can be identified:

- The *explanandum* is well-supported by empirical evidence—if not by *direct* evidence, then *indirect* evidence (involving the use of inferential reasoning). In other words, the *explanandum* is objectively “true”: Most, if not all, relevant “experts” believe the *explanandum* to be “true,” and cite reasons for their belief.
- The statements constituting the *explanans* are also believed, by relevant experts, to be [objectively](#) true (i.e., having “inter-subjective reliability”).
- The statements constituting the *explanans* refer to all of the explanatory (a broader term than “causative”²⁶) factors believed to be of relevance for the *explanandum*.
- The statements constituting the *explanans* do, in fact, “produce” (or “predict”) the *explanandum*—another way of saying that they *explain* the *explanandum*. That is, the *explanandum* is, in fact, logically deducible from the statements comprising the *explanans*: The *explanandum* demonstrably follows, logically, from the *explanans*.

An important qualification to note here is that just because a given *explanandum* is deducible from one set of statements, it does not follow that it cannot *also* be deduced from another set of statements. Meaning that occasionally scientists have before them two or more alternate theories for the same *explanandum*, and may regard all of them as equally acceptable—perhaps only contending that one theory is most acceptable in a certain *context*, another one most acceptable in some other context.

Returning now to the statement that “Evolution is a theory, not a fact . . . ,” we can make the following observations:

- If, in asserting that evolution is a “theory” one means that the *occurrence* of evolution (monotypic and/or polytypic) is in question, one is misusing the word “theory.” For a

²⁶. A factor that is being “held constant” for the purposes of one’s theory is an *explanatory* factor, but not a *causative* one—precisely because it is being held constant, and therefore one that is “assumed away,” and thus cannot play the role of a causative factor.

theory should be thought of as an *explanation* offered by a scientist (or one who thinks like one).

- If, in asserting that evolution *per se* is a “theory,” and one is thinking of a theory as a scientific explanation, one *may* be making a correct statement. For occasionally scientists use the “fact” of (polytypic) evolution to explain certain *other* facts.²⁷ Usually, however, scientists think of evolution, not as something that *explains*, but as something *to* explain (i.e., an *explanandum*)—which is a very different matter.
- If, in referring to evolution as a “theory,” one is not referring to the “fact” of evolution but, rather, to a theory that *explains* that fact, one’s reference to evolution *per se* as a theory is not conveying one’s intended meaning. Rather, it is *obscuring* it, if not actually *falsifying* it.
- In asserting that evolution is *not* a “fact,” one seems to be saying that solid evidence for the occurrence of evolution (monotypic and/or polytypic) is lacking. If this is what one means, in the first place one should have said as much! But, second, if this is what one means, one has made a statement that is not without merit. For although scientific evidence can be adduced in support of the claims that monotypic and polytypic evolution have occurred, this evidence is not entirely satisfactory. Still, most biologists believe the evidence to be strong enough to support their claim that “evolution” is not simply the *name* for something *fictional* (such as a “troll”) but, rather, is the name for processes that *actually occur* in the real world.
- One does not normally refer to a theory as either “factual” or otherwise. Assuming that we are thinking of a theory (properly) as an *explanatory structure*, a theory is usually thought of in “acceptability” terms. In fact, usually theories are judged, not in dichotomous terms (i.e., either acceptable or unacceptable), but in terms of a *continuum*—with “acceptable” at one end of the continuum, and “unacceptable” at the other end. And the *position* of a given theory on this continuum likely will change over time as scientists generate new ideas and new empirical findings.

In summary, the statement that “Evolution is a theory, not a fact . . .” is subject to varying interpretations. Depending on how the statement is interpreted, it is either partially true, confused, or nonsensical. Dr. McCoy’s alternate statement is relatively more acceptable; but neither his nor the School Board’s is clear in its intent; neither conveys a clear meaning.

²⁷. For example, in one place Stephen Jay Gould referred to his “punctuated equilibria” idea as a theory that helped explain “the lack of expected patterns during normal times . . .” The statement occurs in “Death and Transfiguration,” in (pp. 230 - 44) his *The Flamingo’s Smile*. New York: W. W. Norton & Company, 1985. Punctuated equilibria can also, of course, be given the role of *explanandum*, in which case one would like (I would, at any rate!) an *explanans* (i.e., theory) to explain it. Such a theory would be parallel to Darwin’s theory of natural selection, which theory can be thought of (I argue here) as a theory of *monotypic* evolution (Gould’s punctuated equilibria above referring, in contrast, to *polytypic* evolution *as an explanation*, rather than something to explain).

As to comments made by parents on the sticker and its wording, I shall focus just on the claim made by several parents (reported in the *Order*) that the presence of the sticker (the one accepted by the School Board, and affixed in textbooks) could be thought of as fostering critical thinking. An opinion based, of course, on the (generous!) assumption that students would actually *read* the sticker, and reflect on it. I have several reactions to this opinion:

- Why put “warning” labels only in biology textbooks? Don’t other textbooks discuss controversial matters, and shouldn’t they *also* contain warning labels?!
- Isn’t it true that some textbooks (e.g., American history ones) *fail* to discuss certain important topics, so that students should be warned regarding such omissions?!
- Do you want students to develop the habit of thinking critically about *everything* (including religion!), or just evolutionary theory?
- If students learn to think critically regarding evolutionary theory, isn’t there the “danger” that they will apply the principles learned to other topics as well?! Including Creationism/Intelligent Design?! Given that possibility, are you *really* being sincere in your claim that you would like to see critical thinking encouraged, fostered?!
- Is it not true that frequently when people *believe* that they are thinking critically, in actuality they are merely using their biases to identify “flaws” in that which is being “critiqued”? So that their criticisms merely reflect their biases, not genuine critical thinking?
- Given the last point, and assuming that you genuinely want to promote the ability to think critically, how best to promote it? Is the affixing of stickers the answer, or is there a better approach?
- What does a given person *need* to be able to think critically? Is it not true that a person needs, first, a certain degree of *knowledge*?—which can be acquired through reading, listening to lectures, etc. That one needs, second, to be aware of what *questions* one needs to ask?—something which also, to a degree, can be learned? But that, in addition, a certain level of *intelligence/creativity* is required on the part of the student?—which attributes are in large part (but not entirely) a matter of heredity. And that even “native” ability is not sufficient, in that another attribute needed is *persistence* (a fact illustrated, in another context, by the life of Thomas Edison)—a trait that our society (to say nothing of its schools) does little to foster?!
- Beyond the matter of what *traits* students need, there is the question: Do *teachers* have the *capability* (e.g., knowledge and skills) to foster critical thinking in their students? And *will* they do so, if capable? Or will they be afraid of “opening a can of worms,” whose contents might crawl into, e.g., religion—thereby arousing the ire of parents, and *thereby* potentially shortening one’s career (at a given school, at any rate)?

Even if teachers are *able* and *willing* to encourage critical thinking, and do their best to foster it, how *successful* will they be? High school students are at a point in their lives when most of them have other things on their mind; and even those with an orientation to academics are not necessarily good candidates for education in critical thinking: Few have the “native” ability to benefit much from such education, and fewer still (perhaps) have the persistence to struggle with problems until they are resolved (a process that may take years, with answers coming only years after graduation from high school).

In summary, although a number of parents expressed the view that the placement of stickers in textbooks could encourage critical thinking by students, it is difficult to take those parents seriously. The presence of the stickers in textbooks might plant seeds of doubt in the minds of students, but the stickers *per se* would not in the least help students *articulate* (in their own minds, and to others) *why* they should have doubts about evolution. So that the stickers would not be expected to foster the habit of critical thinking—relative to evolution, or any other topic for that matter. Classroom instruction (combined with reading assignments) *could* help students develop some skill in critical thinking.²⁸ But even that would have its limitations; for unless a student is naturally “gifted” (in intelligence/creativity), and has a personality/disposition such that s/he is “driven” to be persistent, that student will not be able to critique at a high level.

If the above discussion of matters related to the *Selman v Cobb County* case suggests that I am not a Creationist/Intelligent Designer, that suggestion is correct! Not that I think of myself as a “secular humanist,” however. I have been a churchgoer virtually all of my life (for what *that’s* worth!), and religion has long been a dominant preoccupation of mine. My views regarding religion, however, have been strongly influenced by the prophetic tradition within Judaeo-Christianity, and also by scholarly work on religion (by such individuals as Burton Mack, Bart Ehrman, and John Dominic Crossan). This is not the place to detail my religious views; suffice it to say that although religion is, and has been, of utmost importance to me, but that my view of religion is such that I have little in common with Creationists and their ilk—and have no serious quarrel with Science. Let me qualify the latter, however, by noting that I have no quarrel with Science *unless* I perceive certain “scientific” work as being insufficiently scientific.²⁹ Which, of course, is my principal reason for writing this book!

²⁸ As a History student in college I appreciated the fact that some of my instructors used readings books that included a variety of perspectives on a given subject (such as causes of the Civil War) so that the student was forced to weigh different arguments. This process often resulted not only in combining different arguments, but developing novel ones.

²⁹ I should add, though, that Science as we had known it in the West is not the only type of Science that has existed. The “primitives” who lived prior to the Agricultural Revolution developed a body of knowledge useful for *survival*—a Science stemming from an attitude of reverence, and focusing on observation and adaptation. During the Agricultural Revolution, however, a (pathological) control mentality emerged, resulting not only in hierarchal social class systems and exploitative economic systems, but a Science focused on experiment and change. Given that the latter sort of science received its support from the dominant class, it developed as a servant of the ruling class—so that scientists became prostitutes “servicing” members of the ruling class. It is true that the “primitives” had their superstitions, but we moderns have our (equivalent) ideologies—allowing us, in good conscience, to kill “heretics,” have slaves, burn witches, place a bounty on “Indian” scalps (i.e. “redskins”), attack a country

My Shakespearean epigraph implies that I not only have problems with Creationism/Intelligent Design, but with certain works by scientists. In particular do I have problems with Charles Darwin's *The Origin of Species*, and I have written this work in part to detail those concerns (focusing specifically on Darwin's "natural selection" concept). Before proceeding to the body of that presentation, however, I would like to conduct a brief parallel analysis of a pro-evolution article that appeared, a few years ago, in a semi-professional magazine.³⁰ Given that this article (with its sidebars) is rather lengthy, and rather professional in appearance, it seemingly is an impressive presentation of the pro-evolution position. But is it? Let us next examine the article, and find out.

The question posed by the article's title—"Was Darwin Wrong? —" is immediately answered³¹ "No. The evidence for Evolution is overwhelming" (p. 4). This suggesting that Darwin's primary contribution was to suggest *that* evolution (monotypic? polytypic? both?) occurs, and has occurred. Statements by the author, indeed, seemingly support this suggestion. For example, his statement (p. 6) that nearly half of Americans³² do not believe that evolution "produced humans." That, i.e., "nearly half the American populace prefers to believe that Charles Darwin was wrong where it mattered most."³³ Also, his assertion that evolution is "a theory you can take to the bank" (p. 8)—given his statement a few lines later that "the supporting evidence is abundant, various, ever increasing, solidly interconnected"

If Quammen is suggesting that Darwin's primary contribution was to assert *that* evolution occurs, he is clearly wrong. For the idea can be traced back centuries in time—a fact that by no means comes through in Quammen's discussion. That is, although the article makes reference to a few relevant contemporaries of Darwin (e.g., [Richard Owen](#) and Alfred Russel Wallace), it makes no effort to document the development of evolutionary ideas through the centuries.

Quammen notes—correctly—that an important contribution of Darwin was to provide evidence for the occurrence of evolution—evidence from biogeography, paleontology, embryology, and

(e.g., Iraq) that posed no threat to us (justifying the attack on the basis of concocted "intelligence," etc. David F. Noble is one of the few scholars to recognize the societal role that science has been playing; see, e.g., his *America by Design: Science, Technology, and the Rise of Corporate Capitalism*. New York: Alfred A. Knopf, Inc., 1977.

³⁰ David Quammen, "Was Darwin Wrong?," *National Geographic*, Vol. 206, No. 5 (November 2004), pp. 2 - 35 (including photographs and sidebars).

³¹ Whether by Quammen or an editor; I suspect the latter, but could be wrong.

³² Assumedly he is referring here specifically to citizens of the United States, not (in addition) Canadians, Mexicans, Brazilians, Chileans, etc.

³³ If the author intends to suggest here that Darwin's focus in *Origin* was primarily on human evolution, he is dead wrong. Darwin's later [The Descent of Man](#), though, dealt with that topic. It is wrong, however, to think that Darwin's primary contribution was the treatment of human evolution—except that Darwin perceived natural selection as a universal law that applied to all species, including humans.

morphology (p. 9 ff.)—insofar as those disciplines were developed in Darwin’s time. But his article fails to emphasize the fact that Darwin’s *Origin* is generally regarded as notable, not so much for providing evidence *that* evolution has occurred but, rather, for creating a (plausible) *theory*—natural selection—to *explain* evolution. (A theory which Darwin evidently thought of as one that explained polytypic evolution—a term never used by Darwin, of course³⁴). It’s true that Quammen begins his article by stating: “Evolution by natural selection, the central concept of the life’s work of Charles Darwin, is a theory” (p. 4). But note here the ambiguity associated with Quammen’s use of the word “theory.”

Is the suggestion *that* evolution occurs a “theory” in Quammen’s mind? Or, rather, does he think of evolutionary theory as an *explanation* of the “fact” that evolution occurs? When, e.g., he states (p. 4) that “Continental drift is a theory,” he does not seem to be referring to an *explanation* of continental drift—i.e., a theory that *explains* continental drift. Rather, he seems to be referring to the empirically-based generalization *that* continental drift occurs. Given that he does not refer to continental drift as *itself* explaining something else (i.e., functioning as an *explanans*), we can only conclude that Quammen is confused as to the meaning of “theory;” for if he were *not* confused, he would not use the term in the inconsistent manner he does.

In making a parallel (p. 4) between evolutionary theory and atomic theory, the motivation appears to be the fact that some refer to evolution as “just” a theory. If one is referring to evolution as “just” a theory, one is not using “theory” in a proper manner. Rather, one is asserting, in effect, that the *occurrence* of evolution is not something that has been substantiated. When, in contrast, one refers to atomic theory as “just” a theory, one means that subatomic particles are being postulated, that movements of those particles are also being postulated—and that neither the particles nor their movements can be observed directly. So that what is being postulated can be established as “real” *only* by making certain predictions based on one’s assumptions, and examining those predictions for their accuracy. Given that predictions can also be thought of as explanations, if one’s predictions are substantiated, one can say that one’s assumptions *explain*—and therefore (given the generality of the assumptions) be thought of as a theory. In that the assumptions of atomic theory are of a speculative nature, one might refer to atomic theory as “just” a theory. But *because* those assumptions are highly predictive, few if any scientists refer to atomic theory as “just” a theory.

“Atomic theory,” then, can be thought of as a theory in the true sense, whereas “evolution,” as usually thought of, is an *explanandum* which not only cries out for confirmation, but for a theory (*explanans*) to explain it. The fact that atomic theory consists of postulated “realities” that cannot be observed *directly* is *not* what makes it a theory. Rather, it is the *fact* that those postulates predict accurately (i.e., explain) that make them a *theory*. Evolutionary *theory* properly conceived (i.e., as an *explanans* explaining the “fact” of evolution) may contain assumptions that cannot be tested directly; but whether it has many or few such assumptions is irrelevant for its status as a theory.

In summary, then, Quammen’s discussion of theories *as theories* is less than satisfactory. He correctly states (p. 6) that a theory is “an explanatory statement that fits the evidence”—if, that

³⁴ One could argue, beyond this, that the *idea* of a distinction between monotypic evolution and polytypic evolution is never clearly stated in *Origin*—if ever stated at all!

is, one interprets “fits” to mean “accounts for.” But his usage of the term “theory” lacks consistency, in that it does not always refer to an explanatory structure (*explanans*) from which an *explanandum* is logically derivable—an *explanans* that “produces” an *explanandum*.

Quammen is, though, to be commended for noting that two “big ideas” are associated with evolution: The evolution of all species as a historical phenomenon, and natural selection, as the main mechanism causing that phenomenon (p. 8). That is, on the one hand there is the matter of the “*fact*” of evolution’s occurrence; on the other hand an *explanation*—natural selection—that *accounts* for evolution’s occurrence (assuming now that evolution *does* occur, and is explained by natural selection)—an argument that explains *how* and *why* evolution occurs. Unfortunately, however, this distinction does not play a guiding role in the organization of Quammen’s article—a fact that can lead to confusion on the part of ill-informed readers.

Also to be noted is the fact that Quammen distinguishes between *anagenesis* and *speciation* (p. 9)—i.e., what I have referred to above as, respectively, monotypic and polytypic evolution. Quammen does not, however, clearly distinguish between these two types of evolution; nor is this distinction used as an organizing principle for his article.

Quammen makes a number of questionable statements in his article, and it will be useful to catalog some of these here:

- He states that what made *Origin* remarkable “was that it offered a rational explanation of how evolution must occur” (p. 8). Later, I question the “rationality” of Darwin’s argument; at this point I simply note that a theory that is “rational” is not *thereby* acceptable.
- He states that Alfred Russel Wallace and Charles Darwin “discovered” natural selection (p. 8). They didn’t; they *created* (or invented) the theory of natural selection. One *discovers* things that exist, but whose existence has not been known; one *creates* things that never existed before.
- His summary of natural selection (p. 8) is cursory (although better than that of Darwin!).
- The fact that Darwin referred to speciation as the “principle of divergence” (p. 9) is not at all enlightening; it is simply a phrase that asserts (without establishing) that polytypic evolution occurs. Shades of Moliere!
- That “principle” (of divergence) does *not* explain “the adaptation of individual species” (p. 9). Rather, it is *adaptation* as it occurs geographically (assuming a varied environment) that “explains” speciation for Darwin (as we shall see in Chapter 7).
- Did Darwin really have “an extraordinary commitment to intellectual honesty” (p. 9)? Some would question this, given, e.g., the machinations that he engaged in (with others) to protect his perceived position of primacy relative to Wallace.
- To refer to *Origin* as “hefty and substantive at 490 pages” (p. 9) raises the question: In

what sense is it the latter? In providing evidence *that* evolution has occurred? In providing a well-stated, clear, convincing theory that *explains* evolution? (If so, monotypic, polytypic, or both?) Or was he simply noting that the book is *heavy*!

- The assertion that “Evolution by natural selection represented Darwin at his best—which is to say, scientific observation and careful thinking at its best” (p. 20) is questionable. Darwin may have been a good observer and collector, but his theory of natural selection is highly problematic—which is a major reason I have written this book!
- The assertion that microbes acquire resistance to drugs as a result of natural selection (p. 21) has two problems. First, it fails to make clear that microbes, at the *species*, not *individual*, level are what is being referred to. Second, attributing the biological change here to “natural selection” is simply wrong—as the discussion in Chapter 9 should make clear.
- If antibiotics exert “a powerful evolutionary force” (p. 21), the type of evolution involved is monotypic, not polytypic.
- The assertion (p. 30) that “Among most forms of living creatures, evolution proceeds slowly . . .” is in conflict with the “punctuated equilibria” generalization proposed by Stephen Jay Gould and Niles Eldredge (see the Foreword). For *that* generalization states (in effect) that most of the time *neither* monotypic nor polytypic evolution occur (!) but, rather, that during a few widely-separate—and fairly short—(from a geologic time perspective) periods, many new species “suddenly” come into existence (with many previously-existing species becoming extinct). So that monotypic evolution is the name for something that simply doesn’t occur! (if one uses the perspective of geologic time); and polytypic evolution is something that occurs, but only sporadically (and is typically accompanied by mass extinctions).
- The research of Peter and Rosemary Grant relative to finch beak size (p. 30) proves nothing regarding (monotypic) evolution. It merely establishes the (unsurprising) fact that *adaptation* occurs. What makes their research of interest is that it demonstrates how *quickly* adaptation can occur—and how *unlinear* it tends to be.
- If William R. Rice and George W. Salt have, in their experiments with fruit flies, caused speciation (or something very close to it) to occur (p. 30), there is no reason to think that the causative factor(s) in their experiments has been operating in the real world. Thus, there is no reason to believe that those experiments help us understand how/why speciation occurs in the *real world* (assuming that it *does* occur).
- “Ideas come and go, but the fittest [ideas] survive” (p. 31). What a sociologically naive statement to make! Where, in fact, is your evidence for this “fact”? Or is evolutionary biology a religion that does not need to prove its dogmas?!

In summary, although Quammen is to be commended for recognizing the distinction between monotypic evolution and polytypic evolution, and seems to recognize that a theory is an

explanation (i.e., *functions* as an explanation), and is to be distinguished from that which it purportedly *explains* (i.e., an *explanandum*) those distinctions play little role as organizing principles for his discussion. Given that fact, it is not surprising that Quammen evinces little grasp of what those distinctions are all about. In addition, he makes a number of questionable assertions. And, inexplicably, he fails to make any reference to the Gould-Eldredge generalization, “punctuated equilibria”—arguably the most important intellectual contribution to the subject of evolution in the past 50 or so years. Indeed, the fact that he claims that evolution (and seems to be referring specifically to *monotypic* evolution) proceeds *slowly* indicates that he is aware that that’s what *Darwin* asserted, but unaware that the “punctuated equilibria” generalization contradicts that claim. Or does Quammen’s silence regarding that generalization indicate that he disagrees with it? If so, we have no way of knowing that from his article.

Problems, then, are associated both with those who are anti-evolution (and perhaps also pro-Creationism/Intelligent Design) and those (using Quammen as an example) who are pro-evolution. Given that I accept the Gould-Eldredge generalization (for the *scale* to which it is intended to apply), and accept that periods of speciation *do* seem to occur, and be associated with periods of geologic upheaval, it appears that a naturalistic theory would explain how and why speciation occurs. What that theory might be, I don’t know: *If* there is such a theory “out there,” I have not yet encountered it. But in principle, the fact of a strong correlation (apparently) here suggests that a naturalistic, rather than *supernaturalistic*, explanation can be created: For why would God choose to create species only during periods of geologic upheaval?! If God’s decisions are highly predictable, we are dealing with a very unimpressive God—an *unbelievable* God, in fact!

The fact that I reject Creationism/Intelligent Design does not, though, mean that I accept without question all that evolutionary biologists have to say regarding evolution. I especially find the theory that biologists still cling to in explaining evolution—natural selection—highly problematic. In invoking the theory, not only do biologists often fail to specify whether they regard it as a theory of monotypic evolution or polytypic evolution; they fail to *understand* the theory, invoking it in situations where it is incorrect so to do. And, they fail to recognize the many problems associated with the “theory”—the main one being that (as I point out later) the “theory” basically has no relevance for understanding evolution as it has occurred in the real world (especially in the case of humans, and the primates in general): What it predicts *may* exist, but insofar as it *does* exist, this is for reasons other than are specified by the theory. This is a serious flaw, indeed!

One of the objectives of this book is to critique Darwin’s theory of natural selection as presented in *Origin*. Before doing so, however, I need to clarify what “natural selection” refers to. For a fundamental fact regarding Darwin’s discussion of natural selection is that it lacks utterly in clarity. This lack of clarity not only makes analysis of the theory difficult, but has led to misunderstandings as to what natural selection is “about.” In the preceding discussion I have identified examples of this confusion, but let me conclude this chapter by listing the various types of misconceptions that have existed in referring to natural selection, giving further examples. Part Two below then is devoted to clarifying the meaning of “natural selection.”

- Bill McKibben made, several years ago, the statement that “There was great Darwinian

pressure to pay attention to the tiger roaring in front of you.”³⁵ The suggestion here is that premature death as a result of predation by members of another species is associated with Darwinian natural selection. Now although it is true that Darwin made reference to predation in *Origin* (as we shall see), this simply indicates the confused nature of Darwin’s thinking—for one cannot logically associate predation with Darwinian natural selection (a point given attention in Chapter 9).

- The “classic” case of temporal changes in peppered moth coloration in England and its correlation with temporal changes in pollution has often been cited as “proof” of the occurrence of natural selection. The truth, however, is rather different: If, in fact, there has been such a correlation, the cause has been *environmental change*, not natural selection. Both natural selection and environmental change can, in principle, cause monotypic evolution (or at least biological change over time); but these involve *different* mechanisms—and natural selection was not the operative mechanism in the peppered moth case (assuming that coloration change did, in fact, occur with peppered moths as claimed). (Chapter 9 identifies and discusses 12 types of selection mechanisms.)
- Gillian Beer has referred to “a gradual process of genetic differentiation and selection under environmental pressures.”³⁶ The suggestion here is that if selection occurs in nature—whether as the result of environmental pressures or other factors—that selection should be termed *natural* selection. The fact of the matter, however, is that “selection” in nature can, in principle, result from (Darwinian) “natural selection”—but can also result from environmental change and sexual selection. Rather different processes are associated with each of those three “mechanisms”!
- “Natural selection” is often thought of as resulting in better adaptation to the environment. Darwin, however, criticized the naturalists of his time³⁷ for explaining geographical variations in life-forms on the basis of geographical variations in “conditions.” In effect, then, although naturalists of Darwin’s time, in explaining geographical variation in life-forms, were tacitly (if not explicitly) assuming that life-forms adapt to their habitat, Darwin’s theory of natural selection explained variation on a *different* basis—the intra-specific competition associated with his “natural selection.” Darwin was, however, confused on this matter, in places seeming to argue one way, in

³⁵ “On Not Quite Getting It,” *Orion Online*, March / April 2005; this formerly was available at www.oriononline.org.

³⁶ “Introduction” to *Origin*, p. vii.

³⁷ Books on the naturalists of the time include Lynn Barber, *The Heyday of Natural History: 1820 – 1870*. Garden City, NY: Doubleday & Company, Inc., 1980; and Philip F. Rehbock, *The Philosophical Naturalists: Themes in Early Nineteenth-Century British Biology*. Madison, WI: The University of Wisconsin Press, 1983.

other places another.³⁸

- The phrase “survival of the fittest”—which was used by Darwin, but not in the initial editions of *Origin*—seems to suggest that natural selection is about fitting the environment. But the “fitting” associated with “survival of the fittest” does *not* refer to fitting the environment. Rather, it refers to the intra-specific competition that is assumed to occur in the natural selection theory: The “fittest” are those individuals with that trait(s) which confers survivability in their competition with conspecifics. This is not to say, however, that fitting the environment plays no role in the Darwinian concept of natural selection. We can summarize the situation by stating that in the Darwinian model *only* those individuals which fit the environment survive; but that not *all* such individuals survive: Individuals that survive include, and only include, those that (a) fit the environment *and* (b) *also* are able to survive the competition that occurs with conspecifics (which occurs because of the excess births assumed to occur—as a virtual “law of nature”). (Commentary on the “survival of the fittest” phrase is given more attention in Chapter 11.) Also, in Darwin’s comprehensive model (presented in Chapter 7), adaptation to the environment plays an important role (which is *not* the case in the “natural selection” portion of that model).

I hope that I have provided enough evidence regarding the ambiguity and confusion surrounding “evolution” and “natural selection” to convince the reader regarding the utter necessity of seeking to provide clarification of these terms—so that the significant amount of space that I devote to “preliminaries” is justified. What follows next, then, are some general comments relative to evolution—their presence here providing necessary background for later comments.

³⁸ Darwin’s thinking regarding inheritance was also confused in that in places he argued against the thesis that acquired characteristics can be inherited, but in other places seemed to accept the Lamarckian hypothesis.

Chapter 2: Some Background Information

There are a few general comments that I would like to make regarding *Origin* and Darwin, and it will be useful to use this chapter to make them. They do not pertain directly to my goals of clarification and criticism, but may help in providing a context for the presentation to follow.

First, the book contains but one illustration, the famous “tree of life” diagram which appears on p. 2—and was discussed by Darwin, beginning on p. 96 (in his Chapter IV, “Natural Selection,” pp. 67 - 107). Given that this diagram can be thought of as embedding much of Darwin’s biological belief system, this is a useful point to begin:

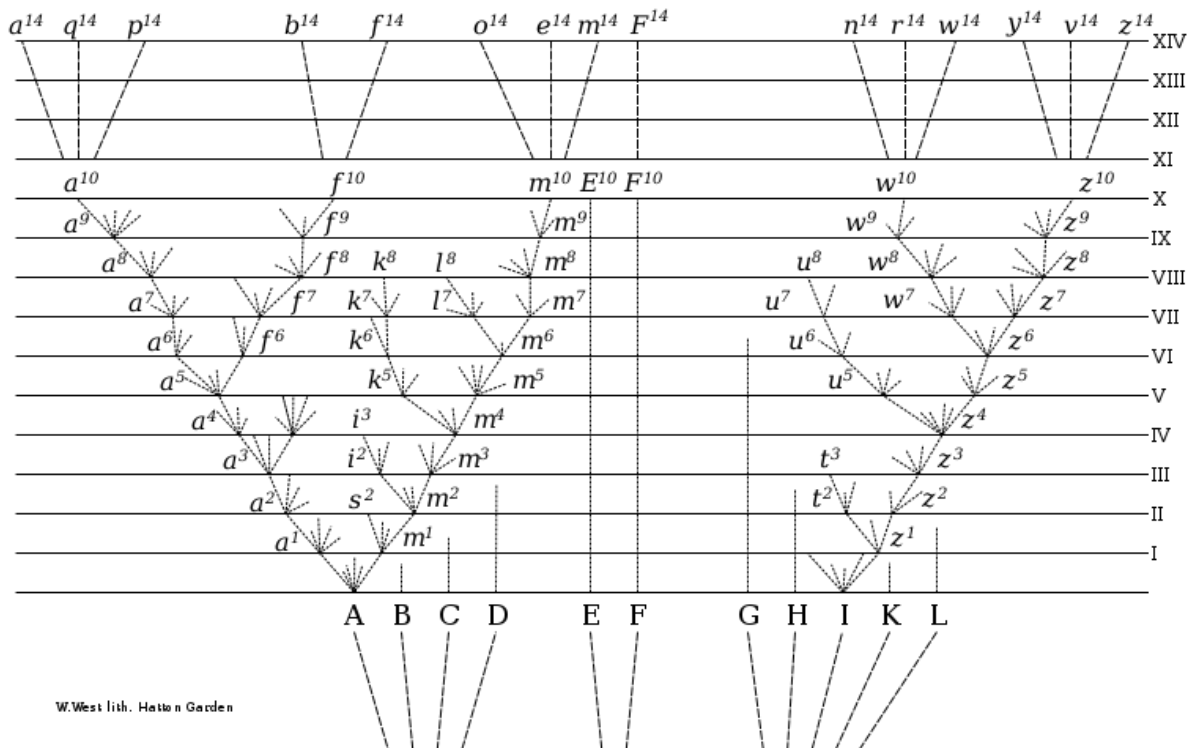


Figure 1: Darwin’s “Tree” Diagram

(from: http://commons.wikimedia.org/wiki/File:Origin_of_Species.svg ³⁹)

If we think of this diagram as a graph with X and Y axes, the Y axis represents time, whereas the X axis doesn’t represent anything. Rather, the X axis—better referred to as simply horizontal space—provides Darwin with space within which he can draw lines—these representing species-varieties. Eleven lines emanate from the bottom of the “graph,” these labeled (by Darwin) A - L (there is no J)—which fact is of interest, in that the diagram itself does not suggest that all

³⁹ The diagram, as it appears in the book I am using (based on the second edition), contains at least 4 errors.

species have a common ancestor. This should not be interpreted, however, as meaning that Darwin did not *believe* this. Rather, one can assume that Darwin created the diagram in his way so as not to have wasted (i.e., basically empty) space on the diagram's bottom. An alternate interpretation is that he wanted to give the impression that he did not necessarily believe that all species had a common ancestor, given the religious sensibilities of the time.

Let us begin by simply describing what the diagram shows:

- Species B and K become extinct before Time I.
- Species C and L cease existence midway between Times I and II.
- Species D and H become extinct just prior to Time III.
- Species G ends its time on earth between Times VI and VII.
- Species E ceases existence at Time X, without producing any varieties during its “career.”
- Species F also fails to produce any varieties, but is still in existence at present (Time XIV).
- Species A and I are the only species that produce numerous branches.
- Oddly, Species A, at Time 0, is able to “spawn” six separate varieties virtually simultaneously, four of which cease existence before the arrival of Time I, however. The “a” line (which seemingly does not continue A but, rather, is the most “authentic” variety produced by A) continues on to the present, in the process spawning an “m” line which continues to the present (and also “gives rise” to “o” and “e” lines), as well as an “f” one (which, in turn, gives rise to a “b” line).
- Species I also produces, at Time 0, several varieties (five), but four of them are short-lived, with only variety “z” (there is no variety “i” for some reason) continuing on down to the present, in the process spawning varieties “t” (short-lived), “u” (which ceases existence at Time VIII), and “w” (which continues down to the present, and produces varieties “n” and “r,” which also continue down to the present).

What can we infer from this diagram regarding Darwin’s biological beliefs?

1. Some simple species somehow came into existence at some distant point in time.
2. One or more varieties developed from that “mother” species.
3. Over time some, if not all, of those varieties changed so much in their characteristics (ones having what we today would call a genetic basis) that they could be thought of as new species. Varieties can, therefore, be thought of simply as (p. 92) “incipient

species”—meaning, further, that a firm boundary cannot be established between “variety” and “species.”

4. The change that has occurred over time has tended to be of a “progressive” nature. That is, the change that has occurred over time has been not only of a *quantitative*, but of a *qualitative* nature.
5. However, the *qualitative* change (in, e.g., anatomical and physiological characteristics) has been of a sort that it is possible objectively⁴⁰ to rank types of differences in terms of “higher” and “lower”—so that, e.g., a human can be ranked as higher than a zebra. (Granted that such a conclusion might follow more from a Linnaean classification than Darwin’s “tree”—note, however, a possible dependence (unconscious on Darwin’s part?) of the latter on the former.)
6. Change proceeded at a slow pace.
7. Change proceeded in a steady, rather than “jerky,” manner.
8. Not all species have “spawned” new varieties . . . which, then, eventually become new species.
9. Not all “lines” have continued on indefinitely—meaning that extinction occurred with some of them.
10. Despite this fact of extinctions with some lines, the general trend of change has been of increasing variety: Not only have more *different* species tended to exist the later the point in time, but the more *varied* in characteristics (e.g., degree of complexity) the later the point in time.

I need to add immediately, however, that not all of these points can be inferred from the diagram, as I had claimed; the additional points that I have added owe their origin to statements in Darwin’s text:

- One can infer that the “mother” species was a simple one only by reasoning that if a given species produces varieties (that eventually become new species), it is unlikely that it would produce varieties less complex than itself: They are likely to be either equally complex or more complex. However, given that in his text Darwin *did* express his expectation that development would be progressive,⁴¹ it follows from this assumption that the initial (“mother”) species would have been simpler than the varieties that it produced.

⁴⁰ Given that the ranking would be done by humans rather than, e.g., turtles there might be some doubt as to the ranking’s objectivity! Turtles are not likely to share with us the same criteria for making judgments.

⁴¹ Even had Darwin never stated this explicitly, it is a conclusion that is logically derivable from the way he defined “natural selection. However, let me qualify that assertion by noting that what natural selection (as defined by Darwin) “predicts” is *quantitative*, not *qualitative*, change.

(For example, in *Origin*[6], p. 160, Darwin declared: “Although we have no good evidence of the existence of an innate tendency towards progressive development, . . . this necessarily follows . . . through the continued action of natural selection.”)

- The diagram suggests that the only change that would occur would be of a *qualitative* nature. However, the sort of change associated with natural selection *per se* is only of a *quantitative* nature (as we shall see in Chapter 8).
- One cannot, of course, infer *rapidity* of change from the diagram. However, Darwin specified in his text that change would be slow (e.g., p. 380).
- Given that the diagram does not seem to suggest that change over time would be “jerky,” by default it would seem that one can conclude that the diagram “says” that Darwin believed that change would be smooth, steady. To reinforce this inference, there are statements in the text that specify this (e.g., on p. 110 he referred to “the accumulative action of natural selection. . .”).

Given that one can infer these beliefs, on Darwin’s part, from the diagram, one (as a modern reader, at least) gains the expectation that the contents of the book would focus on the provision of:

- Evidence that would support each of the above ten points—so that they would represent not simply offhand *opinions* on Darwin’s part. Obviously, Darwin would not be able to supply *direct* evidence in support of *any* of these points but, rather, would be restricted to *indirect* evidence drawn from the various life disciplines of the time and Geology. Indeed, one might expect that *all* of these points would be explicitly stated in a section of the book labeled, e.g., “Assertions, and Supporting Evidence for Each”—and that that section would list the assertions, then systematically provide the best possible extant supporting evidence in support of each.
- An explanation calculated to provide a convincing argument regarding how a given species came to change to such a degree that it could be thought of as a new species. This raises the challenging question: Given that the change involved with natural selection is (as we shall see in Chapters 8 and 9) only of a *quantitative* nature, how can natural selection be thought of as producing the sort of change required for designation as a new species?!
- An explanation for why certain species—or perhaps “lines” is the better term here—become extinct.

Undoubtedly there may be other questions to ask as well. But the above strike me as the important questions that one would want to ask. Keep in mind, however, that as I stated earlier, my interest in this book is in the *explanations* that Darwin offered in *Origin*, thus my only focus herein is on the second and third points.

Darwin, of course, wrote *Origin* for contemporaries, not us moderns; it is not surprising, then, that *Origin* satisfies the above criteria but imperfectly. The question facing Darwin was how to explain variation—over both space and time. Biogeography was fairly well developed in Darwin’s time, and involved little controversy: different life-forms lived in different parts of the world depending on their “designs” relative to physical conditions; leeward slopes had different vegetation than windward ones because of differences in sun exposure; the finches on different of the Galápagos Islands exhibited beak differences in response to differences in conditions; etc. However, animal life viewed from a *temporal* standpoint was a different matter. The great Linnaeus, for example, believed that species were created by God and placed where they “belonged,” and was joined in this belief—including in Darwin’s time—by many of his fellows. And Robert Chambers’ s [1802 – 1871] anonymously-published [Vestiges of the Natural History of Creation](#) [1844], stated Darwin (p. 5), “would, I presume, say that, after a certain unknown number of generations, some bird had given birth to a woodpecker, and some plant to a mistletoe, and that these had been produced perfect as we now see them; but this assumption seems to me to no explanation”

Also on the naturalistic side were two differing views regarding how transmission occurred from parent to offspring. On the one hand was the position of Jean-Baptiste Pierre Antoine de Monet, Chevalier [de la Marck](#) [1744 – 1829], who argued that characteristics acquired by individuals during their lifetimes could be transmitted to progeny. Darwin accepted this position to a degree (especially as he grew older), but generally believed that there were particles of some sort within individuals that “carried” their traits, which traits were transmitted to progeny. Where reproduction was sexual, the traits of the parents were “[blended](#)” (or “fused”)—this being a time when Gregor Mendel’s revolutionary research was not yet known by many. (Henry Charles [Fleeming Jenkin](#) [1833 – 1885] is famous for criticizing Darwin on this score.)

Darwin not only leaned toward accepting a “genetic” version of inheritance, but—taking a broader perspective—believing that all lifeforms had a common ancestor. That after life had somehow come into being on earth—an “event” that had occurred in the distant past, a time far earlier than [Bishop James Ussher’s](#) seventeenth-century declaration that the world had begun in 4003 BCE—the life not only changed but gave rise to new forms of life, and that this had been a continuous process since life began. Such a view of life, during Darwin’s time, may have been held by some intellectuals, but was by no means a common view; indeed, because it had the status of a “heresy,” few would have stated it publicly, even if it was a view that they accepted.

Because Darwin’s views on how life developed were “deviant” for the time, on the one hand he had to be careful in what he said and left unsaid. As I noted earlier, it’s possible that he drew his diagram as he did (beginning with 11 species, not one) for *religious* reasons rather than practical ones. On the other hand, the thrust of his presentation was necessarily affected by the intellectual tenor of the time. He needed to provide evidence that species change was possible, and what better way to begin his book than by discussing “variation under domestication”: This was a subject that many of his countrymen would have knowledge of, and would therefore know that the whole point of breeding was to change (“improve”) a (actually, *part* of a) given species, better to meet some human need or desire.

My point here is that if we moderns have problems in how Darwin put his book together, one point to keep in mind is that he was writing in a certain intellectual milieu: That milieu affected him unawares to an important degree, but also he wrote to convince his *contemporaries*, and therefore chose his content and organization with that purpose in mind.

Although, in commenting on Darwin's writing, it is easy to unwittingly be unfair (because of a tendency to ignore the *context* of his writing—out of one's own ignorance of the time), because we modern lack a version of *Origin* written specifically for us moderns, we have no choice but to comment on what was written in 1859 (or 1869, etc.), and there are a few comments, therefore, that I would like to offer on the book's writing.

The first is that Darwin had an annoying tendency to personify Nature, and ascribe causal efficacy to Natural Selection. Indeed, after *Origin* appeared (in 1859), Darwin was criticized for these tendencies—which criticisms were “answered” by Darwin in *Origin*[6] (pp. 64 - 65). Darwin's justification for treating Natural Selection as a *thing* (indicated by his capitalization of Natural Selection) with the power to choose and act may have some degree of merit. The problem with adopting such a habit, however, is that it may affect one's *thinking*—causing one to forget that Natural Selection is simply the *name* for a *process*—it is *not a thing*.⁴² Potentially causing, then, one to engage in sloppy thinking—especially in terms of how one goes about attributing causation.

Second, although it is not my intent here to comment on *Origin* from a *literary* standpoint,⁴³ the ambiguity of the work deserves to be singled out as a major problem with *Origin*. It may very well be that in the minds of some a *halo* is associated with *Origin* and its theory of natural selection, but I prefer to think of “natural selection” in particular as being surrounded, rather, by a *fog*—as, that is, having an ambiguous meaning. And that insofar as the term has clarity, the meaning given to it in one place in *Origin* does not necessarily coincide with the meaning given it in another place—a point that I develop in Chapter 8.

Philip Whitfield has stated eloquently that: “Viewed in its totality, the range of adaptations of organisms and the web of evolutionary lineages stretching back in time more than 3 billion years are the wonders of the universe. We know of nothing else that is so complex, so interconnected.

⁴². Darwin was ostensibly aware of the dangers of personification, but in *Origin*[6] declared (p. 65) that it is “difficult to avoid personifying the word Nature; but I mean by Nature, only the aggregate action and product of many natural laws, and by laws the sequence of events as ascertained by us.” But although Darwin *claimed* this, in fact he often attributed *agency* to Nature. Note that the problem with personifying Nature is twofold. First, one attributes agency where one should not. Second, because of this, one *fails* to determine that to which one *should* attribute agency. Thus, Darwin should not have been so sanguine about this bad habit.

⁴³. The *structure* of the book was analyzed several decades ago by M. J. S. Hodge, “The Structure and Strategy of Darwin's ‘long argument,’” *British Journal of the History of Science*, Vol. 10 (1977), pp. 237-46. See also Francis Hitching for valuable comments on the writing style of *Origin*. Francis Hitching, *The Neck of the Giraffe: Where Darwin Went Wrong*. New Haven, CT: Ticknor & Fields, 1982, pp. 247-51.

And it was all made by the process of natural selection.”⁴⁴ But this is a claim that is questionable—if only because natural selection itself is ambiguous in meaning.⁴⁵ At later points in the presentation (and especially in Chapter 8) I “flesh out” this assertion regarding ambiguity in *Origin*. At this point let me simply note that from the standpoint of the book’s literary merit (or lack thereof), the book’s lack of clarity implies that commentary on the book is somewhat of a treacherous matter because the argument of the book is not well presented (and not only from a modern perspective, I would assert). I believe, however, that the interpretation that I give “natural selection” herein (especially at the end of Chapter 8) is a reasonable one that is consistent with what Darwin wrote in *Origin* (especially when subjected to logical analysis)—and also consistent with interpretations given by others. Indeed, I devote an entire (but short) chapter (Chapter 10) to presenting an argument—using logic along with statements from *Origin*—in defense of my interpretation (i.e. “translation”!) of the meaning of “natural selection.”

What accounts for *Origin*’s lack of clarity? One possibility is that Darwin *deliberately* made his argument somewhat amorphous so as to avoid unduly antagonizing the English clergy (thereby quite possibly making him a social outcast—and rendering his efforts fruitless): We must keep in mind that Creationism was part of the conventional wisdom of the time.⁴⁶ As Ernst Mayr has stated, “When Darwin introduced natural selection as the agent of adaptation[⁴⁷] he did so as a replacement for supernatural design.”⁴⁸ Given this, and that Creationism was “in” at the time, Darwin needed to exercise care in discussing biological change, so that his (privileged) position in society would not be jeopardized (to say nothing of his standing in his wife’s eyes!⁴⁹).

If part of the reason for *Origin*’s lack of clarity was Darwin’s earnest desire not to become a martyr while, yet, being a “heretic,” another part of the reason likely is the fact that Darwin was

⁴⁴. Philip Whitfield, *From So Simple a Beginning: The Book of Evolution*. New York: Macmillan Publishing Company, 1993, p. 91. The title of this book was derived from the last sentence of Charles Darwin's *The Origin of Species*.

⁴⁵. For the same reason is it foolish to assert that “of course” natural selection occurs. Phillip E. Johnson, *Darwin on Trial*. Downers Grove, IL: InterVarsity Press, 1993 (second edition), p. 16.

⁴⁶. By 1859, however, Creationism was losing its grip. The publication, in 1844, of *Vestiges of the Natural History of Creation*, by Robert Chambers, helped create an intellectual climate that made *Origin* at least somewhat acceptable. Loren C. Eiseley, *Darwin's Century: Evolution and the Men Who Discovered It*. Garden City, NY: Doubleday & Company, 1958, p. 134.

⁴⁷ Mayr was wrong in referring to “natural selection as the agent of adaptation”—a point that I comment on in, e.g., Chapter 8.

⁴⁸. *Toward a New Philosophy of Biology: Observations of an Evolutionist*. Cambridge, MA: The Belknap Press of Harvard University Press, 1988, p. 151.

⁴⁹. His wife has been described as a “devout Christian,” but assumedly that means only (and rather trivially) that she participated in devout observances on a regular basis—and did so with a properly devout demeanor.

writing under pressure. As is commonly known, Darwin had received (in mid 1858) some correspondence from Alfred Russel Wallace which presented ideas virtually identical with his own “hard-earned” ones. This put Darwin in a panic, because he wanted to be sure that *he* (not being a person without ego!) received credit for these ideas, not someone else. Darwin (and friends) then engaged in various machinations to ensure that priority for development of the ideas would be credited to him. This included writing up his ideas in a fuller fashion than he had done before (in papers not for publication), the end result being *Origin*, published in late 1859. The fact that Darwin was writing under pressure may very well have contributed to whatever literary deficiencies the work has—including its lack of clarity and seeming contradictions.

My primary focus in the pages that follow (until near the end) is on Darwin’s “theory” of natural selection, but at this point some general comments on evolution and natural selection are in order. First, as later chapters should make clear, logically one begins a research project by establishing generalizations, and *then* creating a theory(ies) to explain them. Darwin’s theory of natural selection, at least, however, can be thought of as having been created to explain a generalization (i.e., *that* monotypic evolution occurs) with only *supposed* empirical support. Granted that during Darwin’s time the geological evidence for evolution (monotypic and/or polytypic) was rather limited compared to 2009. Still, the evidence that Darwin worked with concerning monotypic evolution was rather weak—and seemingly derived, not so much from the “historical” record, but from breeding experience (including his own).

Second, insofar as one *can* give “natural selection” (as used by Darwin in *Origin*) a clear meaning, one finds that it has a *shifting* meaning in *Origin*. Indeed, in Chapter 8 I identify four different meanings that “natural selection” has in *Origin*. These four meanings are of interest in that all relate *only* to monotypic evolution—differing one from another, but only in *scope*.

Third, there are questions regarding the *originality* of Darwin’s theory of natural selection.⁵⁰ For not only had Alfred Russel Wallace arrived (almost simultaneously) at ideas that were virtually identical to Darwin’s, but so had, e.g., [Edward Blyth](#) [1810 – 1873] and [Patrick Matthew](#) [1790 – 1874]—in the 1830s (thereby definitely predating Darwin).⁵¹ Besides, one can also argue that *Origin* lacks originality in that it is merely a “biologized” and *dynamic* version of *laissez faire* (economic) theory (which theory is *static* in the sense that it does not deal with change over time), that theory receiving its classic exposition in [Adam Smith’s](#) *The Wealth of Nations* (1776). For not only does *Origin* draw terminology (e.g., “economy of nature”) from the economic realm; conceptually, *Origin* draws upon *laissez faire* theory (which *itself* lacked originality in

⁵⁰. Darwin himself, in his Historical Sketch at the beginning of *Origin*[6], referred to a paper published (1818) by a Dr. [William C. Wells](#) [1757 – 1817] which (p. 4) “distinctly recognises the principle of natural selection, and this is the first recognition [by anyone] which has been indicated; but he applies it only to the races of man, and to certain characters alone.” Darwin also noted that Wells had stated that (p. 5) some are “better fitted than the others to bear the diseases of the country.” This Historical Sketch, I might note, did not appear in the original edition of *Origin*.

⁵¹. See [Loren Eiseley](#), *Darwin and the Mysterious Mr. X: New Light on the Evolutionists*. New York: E. P. Dutton, 1979. I should add that this book is today widely regarded as outdated, and I do not question that judgment.

that it drew upon (Isaac [Newtonian](#) [1642 – 1727] physical concepts⁵²). (For those interested in pursuing this question I recommend John Wilkens’s “.Darwin’s Precursors and Influences: Conclusions of This Essay,” available on the www.talkorigins.org web site. This essay contains an excellent discussion of the issue (one generally favorable to Darwin—but a fair analysis, nonetheless), and a chart that provides a useful summary of who originated what.)

Fourth, insofar as one can eliminate the book’s ambiguity there is the problem that the book’s key concept—that of natural selection—is never actually *developed* in the book: The meaning given the term at the end of the book is as shallow and undeveloped as that given it at the beginning. Darwin may have viewed his book as “one long argument” (as he stated at the beginning of the last chapter of *Origin*, p. 371); but insofar as that is the case, his “long argument” involves no real elaboration, deepening in meaning, of the term “natural selection”—for the simple reason that his writing does not, in fact, constitute a coherent argument—“long” or otherwise.. This is unfortunate, given the importance of the concept (for his book), and that Darwin had ample opportunity to develop an ever more sophisticated meaning for natural selection in his book. It is, of course, highly ironic that although Darwin’s natural selection “theory” predicts slow, steady, progressive change for *species* (plural) his discussion of the *theory* exhibits no comparable development!

In a sense, Darwin had no excuse for this failure (except for the very real possibility that he lacked the intellectual orientation for developing a cogent argument). For (as I noted in the Foreword) several decades prior to *Origin*’s publication, *Der isolierte Staat* (first published in 1826), by German Johann Heinrich von Thünen [1780-1850], had introduced a new research procedure, that of model building and testing, from which Darwin could have gleaned valuable ideas. Thünen had begun his work by constructing a simplified deductive model (pertaining to agricultural activity viewed geographically), but then developed (“complexified”) the model by progressively introducing more realistic assumptions. Thünen’s goal here was to arrive at a version of the model which could “predict” a real-world situation as accurately as possible—thereby providing an adequate explanation of that situation.

Although Darwin also used this sort of “if . . . then” thinking in *Origin* (e.g., at the beginning of Chapter IV), but he did not do so in as rigorous a fashion as had Thünen. As a consequence, no *maturation* occurs with the concept of natural selection in *Origin*, so that the term remains undeveloped (and therefore ambiguous) throughout the book. Evidently, Darwin was unaware of Thünen’s classic work; but even had he been (i.e., if someone had translated passages of it for

⁵². In 1931 the Soviet theoretician [Nikolai Bukharin](#) [1888 – 1938] even questioned the originality of Newton!—arguing that Newton’s experiments and theories “had been shaped by the new economic demands of England’s merchant classes.” (Steven Rose, *Lifelines: Biology Beyond Determinism*. New York: Oxford University Press, 1998, p. 51.) Thus, one could argue that what Newton was for the rising merchant class of his time, Darwin was for the rising industrialist class of *his* time. That is, each developed theoretical ideas purporting to explain aspects of the natural world, but each body of theory was used by others to develop econo-sociological theory that not only supposedly explained societal phenomena but buttressed valuations and prescriptions. Valuations and prescriptions, in fact, which helped a certain class of people to rise to a position of societal dominance relative to others in their society.

him), it is doubtful that Darwin had the intellectual orientation to benefit from the work. Darwin, after all, was what today we would call “mathematically challenged,” and more at home in the realm of factual data than theorizing/modeling.

A point that I wish to emphasize is that the scope of my discussion below (in the first, and lengthiest, part of the book) is deliberately circumscribed in various ways. First, it is *not* my intention here to present a *comprehensive* critique of *Origin*; my focus, rather, is limited to Darwin’s concept of natural election as discussed in *Origin*—and I assume throughout that natural selection purportedly explains monotypic, but not polytypic, evolution. Second, and related to the first point, in commenting on Darwin’s theory of natural selection I confine myself to *Origin*, ignoring other writings—published and otherwise—by Darwin.

Third, I realize that Darwin had many antecedents: such predecessors as [Pierre de Maupertius](#) [1698-1759], [Georges Louis Leclerc, Comte de Buffon](#) [1707-1788], grandfather Erasmus Darwin [1731-1802],⁵³ Jean Baptiste Pierre Antoine de Monet, Chevalier de Lamarck [1744-1829], Patrick Matthew [1790-1874], Robert Chambers [1802-1871], Richard Owen [1804-1892], Edward Blyth [1810-1873],⁵⁴ and Alfred Russel Wallace [1823-1913]. But I do not discuss their contributions here (relative to natural selection or evolutionary thinking in general), making only a passing reference to a given predecessor (or contemporary) from time to time.

Finally, I wish to make clear at the outset that I do *not* view this critique as some sort of contribution to the Creation-Evolution debate; I do not, e.g., ask herein whether “evolution is true”—alluding here to a book by Sylvia Baker⁵⁵ With Michael J. Behe I would say that “I find the idea of common descent [i.e., the proposition that all living things have a common ancestor] fairly convincing, and have no particular reason to doubt it.”⁵⁶ And I agree with evolutionist Niles Eldredge that if all living things are descended from a common ancestor, they should have certain things in common—and they *do* (e.g., ribonucleic acid, or RNA).⁵⁷ But it is *not* my purpose here either to “prove” or “disprove” (monotypic and/or polytypic) evolution; rather, my basic purpose (fulfilled in the second part of the book) is simply to clarify and critique Darwin’s theory of natural selection as presented in *Origin*.⁵⁸ And one of the points that I wish to make in

⁵³. For a fairly recent biography see Desmond King-Hele, *Erasmus Darwin: A Life of Unequalled Achievement*. London: Giles de la Mare Publishers Ltd., 1999.

⁵⁴. See Eiseley, *Darwin and the Mysterious Mr. X* This book discusses especially Blyth and Matthew.

⁵⁵. Sylvia Baker, *Bone of Contention: Is Evolution True?* Sunnybank, Queensland, Australia: Creation Science Foundation Ltd, 1990 (third impression).

⁵⁶. Michael J. Behe, *Darwin's Black Box*. New York: The Free Press, 1996, p. 5.

⁵⁷. Niles Eldredge, *Dominion*. New York: Henry Holt and Company, 1995, pp. 19-20.

⁵⁸. I assume, though, that Brian Goodwin is correct in asserting that “the large-scale aspects of evolution remain unexplained, including the origin of species.” Also, I agree with Robert G. Wasson that “Organisms evolve as part of a community, that is, an ecosystem”—meaning that an adequate theory of evolution would need to use a different approach than that taken by Darwin. (Brian Goodwin,

this discussion is that *Origin* is basically not a book about *polytypic* evolution⁵⁹ (as is commonly believed) but, rather, a book about *monotypic* evolution. At any rate, it is a book that uses the term natural selection over and over again!

How the Leopard Changed its Spots: The Evolution of Complexity. New York: Charles Scribner's Sons, 1994, p. viii; Robert G. Wasson, *Beyond Natural Selection*. Cambridge, MA: The MIT Press, 1991, p. 157.)

⁵⁹ About, that is, providing an *explanation* of polytypic evolution; rather, it provides various sorts of evidence in support of the claim *that* polytypic evolution occurs—quite a different matter.

Chapter 3: The Data Matrix

The purpose of Part One is to develop a vocabulary that will enable understanding of the presentation in Part Two (which focuses on arriving at a meaning for “natural selection”). Part One consists of three chapters, the current chapter discussing the data matrix, Chapter 2 variation, and Chapter 3 the nature of explanation, specifically as it relates to Darwin’s “natural selection” as an explanation offered by Darwin to explain polytypic evolution, but (unknowingly) for monotypic evolution only in reality. The subject of explanation has already been given some attention in both the Foreword and Preface, but Chapter 3 adds additional observations on the subject.

Let me begin here by noting that what provides impetus for an empirical study is a desire to discover something about, or test a hypothesis regarding, a certain type of thing. (The “thing” in question is usually a tangible, discrete object, but need not be.) In either case, what is involved is the selection of observational *units* and *variables* (i.e., characteristics for which observations will be made), followed by the acquisition of (numerical) *observations* (“values”) and, finally, the “manipulation” of those values in an appropriate fashion given one’s intentions. In obtaining values, one usually will use the “highest” measurement scale possible, and obtain values that not only are *accurate*, but *precise*—i.e., as precise as *necessary* (not necessarily as *possible*), given one’s objectives.

The *precision principle* is also followed (ideally, at any rate) in creating a *theory*. Meaning that a theory’s *explanandum* (i.e., that which the theory purportedly *explains*) is stated precisely, as are the statements constituting the theory proper (i.e., the *explanans*).⁶⁰ This is not to say that the precision principle is the *only* guiding principle in creating a theory—any more than it is the only principle that guides an empirical study. The principle is, however, an important one to follow in creating a theory; for if not employed, the result is a theory with ambiguity in the *explanandum* and/or *explanans*. Why is that a problem? If the *explanandum* is ambiguous, no basis exists for determining whether the *explanans* being offered actually explains it. And if the *explanandum* is clear, but the *explanans* contains ambiguous statements, the *explanans* will be *incapable* of “producing” a clear outcome—so that it then, in effect, becomes an explanation that “explains” any number of *explananda*, thereby explaining *nothing* in particular. And if a theory’s *explanandum* and *explanans* both lack in clarity, well . . . then the theory must be Charles Darwin’s theory of natural selection! (More—much more—on this in later chapters!)

The point here is that clarity and precision are desired in both empirical and theoretical work, and that such qualities are lacking in *Origin*. Granted that we must not judge scientific works published in the 1850s using the standards of 2009. Still, as moderns living in 2009 we must admit that *Origin* has flaws, and that it is important to recognize them. Although my focus here is on *Origin* as a work which presents theoretical material, it will be useful to begin the presentation in this Part by discussing a concept that underlies empirical research—the data matrix. What makes such a discussion “useful” is that—ideally, at least—theory-building is not

⁶⁰. Note that when “precise” is used in conjunction with statements, the reference is to *clarity* (or lack of such); when “precise” is used in conjunction with *observations* (“values”), the reference is to *exactness* (or lack of such).

something that occurs in a vacuum isolated from empirical research but, rather, is something that has its basis in empirical findings. Solidly-established empirical findings, I should add.

Figure 2 below depicts the format of a data matrix. As the figure indicates, such a matrix consists of (a) units ($U_1 \dots U_n$), upon (or for) which observations are made, (b) variables ($V_1 \dots V_p$), for which observations are made, and (c) numerical observations ($O_{11} \dots O_{np}$) obtained for the various observational units for the variables included in one's study. The matrix suggests that an empirical research project involves, first, choosing units to study (usually a sample of a larger population), then choosing variables (i.e., characteristics) for which to gather data, and, finally, the actual acquisition of numerical observations (often termed "values," because they are numeric).

	V_1	V_2			V_j		V_p
U_1	O_{11}	O_{12}			O_{1j}		O_{1p}
U_2	O_{21}	O_{22}			O_{2j}		O_{2p}
U_i	O_{i1}	O_{i2}			O_{ij}		O_{jp}
U_n	O_{n1}	O_{n2}			O_{nj}		O_{np}

Figure 2: The Data Matrix

A few comments regarding the elements of a data matrix are in order, beginning with the fact that ideally the researcher is able to obtain an observation for each unit/variable combination in his/her study, but this is not always possible. Thus, it is possible that a "completed" data matrix will contain a few empty cells; no cell, however, will contain more than one observation.

The units studied usually are discrete, tangible things. And although various distinctions can be made regarding units, it is only of importance to note here that units can be either singular or plural; for example, the units for a given study might be human individuals (singular), or might be families (plural). I need also to add, however, that units need not be discrete, tangible things. They can, e.g., be locations, such as locations at which meteorological observations are made, for which observations temperature maps (using "isotherms"), for example, are obtained.

Variables are characteristics that the units in question are *capable* of having, and characteristics for which observations have, in fact, been made. Again, various distinctions can be made regarding variables, but I will mention here only that some variables refer to *internal*

characteristics of the units, some to *external* attributes. For example, assuming families as the units of the study, “family income” would be an internal variable, “distance from nearest shopping mall” an external variable. In Sociology, a type of external variable commonly used is the *contextual* variable; for example, given human individuals as units, the variable “educational level of father” would be a contextual variable—the idea here being that contextual variables help explain characteristics (behavioral and otherwise) of individuals with which they are associated.

Observations are numerical values, and can result either from *counting* or *measuring*. If values are obtained via counting, we would say that the *absolute* scale has been used, consisting of whole (positive) numbers (only) beginning with zero. For example, given families as units, “number of automobiles owned” would be expressed as a whole number—zero or greater.

Measuring can involve a number of different measurement scales, but here I will refer to only three. A *nominal* scale recognizes that variations exist, but that they are thought of in *kind* rather than *degree* terms⁶¹. Thus, a common use of the nominal scale is to think in *dichotomous* terms, observing whether units either have (“1”) or do not have (“0”) some attribute. *Ordinal* and *continuous* scales recognize *degree* variations, with the *ordinal* scale used for *ranking* units in terms of some attribute, using whole numbers beginning with 1. Beauty pageants, e.g., use this scale. However, this scale is commonly used in conjunction with a *rating* scale. That is, a series of judges may be used, with each rating the contestants on, e.g., a 10-point scale, with ratings perhaps allowed to one decimal place (e.g., 7.3). The individual ratings are then aggregated, and then put in rank order, for it is the rank order that is of ultimate interest. The use of several judges to create ratings is based on the assumption that the judgments involved are subjective ones, so that the use of several judges will serve to cancel out biases—especially if the highest and lowest scores are dropped. Often, then, the nominal scale is used in conjunction with another scale—such as the rating scale, or even a “higher” type of scale (e.g., the ranking of football teams on the basis of win-loss record).

A type of rating scale often used in gauging the strength of opinions regarding various matters is the [Likert scale](#). Commonly this consists of a 7-point scale with a +3 at one end (strongly agree) to 0 (no opinion or neutral) to -3 (strongly disagree). The individuals queried are presented with a series of statements, and are then asked to express their opinions by choosing one of the numbers on the scale. The reason for using a 7-point point scale is the belief that those queried would be able to make up to seven distinctions, but not more than 7.

Two common *continuous* scales are the interval and ratio scales, these differing in that an absolute zero is associated with a *ratio* scale (e.g., the Kelvin temperature scale) but not with an *interval* one (e.g., the Fahrenheit temperature scale). There are differences in the properties of

⁶¹. It may be useful to note here that monotypic evolution, by its very nature, involves *quantitative* change (i.e., change in degree/amount), but not *qualitative* change (change from one *kind* to another kind). Polytypic evolution, in contrast, by its very nature involves *qualitative* change (i.e., the emergence of new species), and may or may not also involve monotypic evolution. Someone who believes that both monotypic and polytypic evolution occur necessarily believes (it would seem) that polytypic evolution is *accompanied* by monotypic evolution on the part of most, if not all, of the species involved.

these two scales, but what I wish to emphasize here is what they have in common: Observations are expressed in decimal terms, with the number of decimal points used indicating the precision of measurement.⁶² Needless to say, if an interval or ratio scale is used in a given study, it is assumed that a fixed level of precision has guided *all* of the measurements—and that the number of decimal points associated with a given observation indicates the actual degree of precision used in obtaining the observation.

Finally, I should mention that observations may be expressed as decimal fractions (or percents, if multiplied by 100), and that fractions can be derived various ways. For example, given Iraqi cities as the observational units, fractions might be determined by dividing “number of women and children killed by Coalition forces” during some given time period by “number of residents in city.” Or, again using Iraqi cities as observational units, fractions might be obtained by dividing “number of square yards (from a planimetric standpoint) of buildings *destroyed*” by “number of square yards (from a planimetric standpoint) of buildings *present* before bombing by Coalition forces” during a given time period. Occasionally, fractions will be obtained in such a way that the total of the observations in a given column will be “1.00.”

The observations in a given column must, of course, all be of the same *type*—i.e., they must be *comparable*. Values in *different* columns need not be of the same type, though. I should mention, however, that empirical scientists usually prefer that their observations be either counting numbers or values obtained via the use of an interval or ratio scale. If a given attribute is regarded as important, but does not lend itself to such quantification, that latter fact does not, however, disqualify its use. The point is to use as variables ones judged as *relevant* and *important* given one’s objectives, rather than insist that one confine ones study to variables for which one can use a “higher” order of measurement.

Once one has achieved a completed (or nearly so) data matrix, one may determine, e.g., mean and standard deviation values for each variable, and may create histograms for each. (Examples of these will be given later.) Usually, however, one’s interest is in comparing *columns* of data using, e.g., regression and correlation analysis, etc. Occasionally there is an interest in identifying *groups* of units (taxonomy, or a *posteriori* classification), and this is accomplished by comparing *rows* of observations (perhaps after the observations in each column have been “standardized”). The reason for standardization is that typically the values in different columns are of a different nature, and therefore cannot be compared—until they are standardized.

We usually think of a completed data matrix as having a fairly large number of rows, but there are exceptions. Assume, for example, that one’s interest is in determining how average length varies over time for adult rabbits within a given area. In this case we can think of a data matrix with one row (representing the given area), and a number of columns, each representing, e.g., a year (in sequence). At some given point in time for the first year each rabbit in the area would be located and measured (good luck!), those values summed, and divided by the total number of rabbits to give mean adult rabbit length. That number would then be entered in the first cell (O_{11}). The same would be done for each successive year (up to p years). Finally, a graph might be constructed, with “year” on the X axis and “length” on the Y axis, to help one more readily

⁶². So that, e.g., a value of 1.1 is more precise than 1.; a value of 1.11 is more precise than 1.1; etc.

discern how the variable in question (length in this case) varies over time. (Examples of such graphs are presented in Chapter 5.)

Darwin's theory of natural selection on the one hand *assumes* variation (a) within a given species (b) within a given area—(c) at a specific moment of time. It then uses that assumption in conjunction with others to “predict” variation over *time* (i.e., directionality in particular). Given the importance of the concept of variation in Darwin's thinking, it is desirable next to say some words regarding that topic—done in the next chapter.

Chapter 4: Variation

If evolution is about anything, it is about *variation*. Variation of a certain sort (at a *given moment* of time) is *assumed* in Darwin's "theory" of natural selection; and what the theory *predicts* is variation (of some attribute(s) *over time*). Because of the centrality of the concept of variation to the ensuing discussion, it is useful to isolate it as a topic for treatment—which I do in this chapter. I begin by discussing variation in the context of the data matrix, then broaden the discussion, and conclude by conveying ideas expressed by Darwin on the matter in *Origin*.

A. Variation in Data Matrix Terms

The starting point here is to recognize (as I noted in Chapter 3) that a *quantitative* description may involve either *enumeration* or *measurement*. An enumeration answers the question "How *many*?"—it involves counting—and use of whole numbers (positive ones only) beginning with zero to accomplish one's describing. Before counting begins, however, one must decide *what* to count, so that one is counting just one *kind* of thing. For the objective in counting is to *include* all individuals that one wishes to count, but to *exclude* all other individuals. (Note that "individual" is used here in a generic sense.)

Numbers were first used for making enumerations, but for many centuries have also been used for expressing measurements. A *measurement* can be thought of as answering the question "How *much*?"—although this is not true in all cases. For in the case of measurement there are different measurement *scales*, one of which (the nominal) deals with differences in *kind* (and, thus, *not* quantity), the others, though, deal with differences in *degree* (facts pointed out in the previous chapter).

The "measurement" scale that deals simply with differences in *kind* is called the *nominal* scale. It involves the identification of categories (perhaps using a sophisticated quantitative procedure—but not usually), such as different colors. Commonly, a name is given to each category (e.g., "blue," "red," etc.), but at times numbers may substitute for names. For example, one might classify people on the basis of eye color, identifying just two categories—those with brown eyes and "other" (i.e., one might dichotomize). One might then assign a "1" to those with brown eyes, and a "0" to those with "other" eye color.

If individuals have been "measured" on the basis of a variable for which a nominal scale has been used, but one wishes to use *groups* of individuals as one's observational units, one will need to do a counting for each group (e.g., the number of those with brown eyes). One may then wish to "standardize" one's group values by expressing them as decimal fractions or percents (e.g., 34% of the individuals in a given group have brown eyes). One now has numerical values that are more susceptible to various types of statistical manipulation.

If the observational units of interest are thought of as varying in the *degree* to which they possess some trait(s), a *continuous* measurement scale is commonly used. (The *ordinal* scale, involving ranking, is a discontinuous scale that is useful for certain purposes—e.g., beauty contests—but is

not given attention here.⁶³) If a continuous scale is used, one can think of the scale itself as being represented by a straight line, with numbers (representing observational units) evenly spaced along the line. A zero may be placed at the far left end of the line (if the scale is a *ratio* one—e.g., if the weight of individuals is being measured). But the zero may in some cases be placed at some point to the right of the left end, so that the numbers to its left are *negative* ones. In this case the scale is an *interval* one, and it differs from a ratio scale mainly in that it lacks an absolute zero; the Centigrade temperature scale is an example of an interval scale (whereas the Kelvin scale⁶⁴ is a ratio one).

Whether, for a given variable, a ratio or interval scale is being used, once one has obtained a numerical *value* (such as weight in pounds) for a given observational unit, one can represent that unit as a point on the scale (see below, Figure 3). Actually, however, one can think of the “point” as occupying a certain length on the scale, the amount of that length depending on the degree of precision used in measuring. Thus, “153.4 pounds” is a more precise value than “153 pounds”—and therefore can be thought of as occupying a narrower band on the given line representing the measurement scale.⁶⁵ It goes without saying that the number of decimal points used in a given measurement value *must* reflect the actual degree of precision involved in performing the measurement. If this is not the case, the value is a dishonest one.

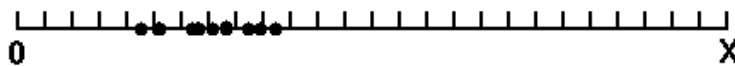


Figure 3: A Linear Scale

Another numeric scale often used in, e.g., studies by sociologists and psychologists is the (Rensis) Likert scale—a subjective scale commonly used in gauging the strength with which human individuals possess opinions. Use of such a scale can be useful for grouping (i.e., categorizing) people on an opinion basis. In this case “row analysis” would be involved whereby the “attitudinal profile” of each individual would be compared with the like profile of each other person in the study, and a mathematical grouping procedure would then used to identify groups—the objective here being to group those with similar profiles together.

At times the observational units for a study will be groups, rather than individuals, but values for the groups are commonly obtained by somehow aggregating numerical values for the individuals

⁶³ Ranking is usually done on a subjective basis, but need not be. For example, football teams in a given group are ranked on the basis of win-loss record expressed as a decimal fraction—because what is of importance is not the fractional value *per se* but, rather, the rank of a team relative to other teams in the group.

⁶⁴ Named for [William Thomson](#), first Baron Kelvin (i.e., Lord Kelvin).

⁶⁵ What 153.4 “means” is “somewhere between 153.35 and 153.45;” what 153 means is “somewhere between 152.5 and 153.5.” Etc.

comprising the groups. Frequently, for example, an *average* will be determined for each group. This is only possible if individuals were measured on a continuous scale (e.g., a ratio scale) or absolute scale of counting numbers; the most common type of average determined is the *mean*—obtained by summing the individual values for a group, and dividing the total by the total number in the group. It should be unnecessary to state that normally values are obtained for *several* (not just one) observational units (whether they are individuals or groups), because the interest is in *comparing* the observational units in terms of one or more variables (i.e., “column—or V—analysis”). Given this interest, it is, of course, essential that all of the observational units be of the same type—i.e., be comparable, so that one is comparing apples with apples.

Once (accurate) values have been obtained for a set of observational units (individuals or groups) for a given variable(s), the interest is in *how* the variables vary together (i.e., “correlate”) and *why* they vary. Usually the values involved will pertain to units in a certain limited area and for a particular point in time. The values may, however, each be associated with a particular location (but pertain to a particular point in time). Or, on the other hand, the values may be associated with a particular location (which could, though, be the entire earth), but refer to *different* points in time. The values cannot, though, have *both* geographical *and* temporal dimensions.

From a data matrix standpoint, one can use several different perspectives in referring to variation. At the simplest level one can refer to variation as expressed by values in a given *column*. Were the values in a given column to be *identical*, we would say that they exhibit a complete absence of variation. Such a column of values would be unlikely if measurements had been performed, and even unlikely if an enumeration had been performed (of course!). At any rate, a column of identical values would not only be unlikely, but be of little or no interest if obtained.

Normally, the values in a given data matrix *column* will differ one from another—which does not mean, however, that it might not contain two or more identical values. Whether it does or not, normally the values in a column *vary*—i.e., differ one from another. To illustrate *how much* they vary, one may arrange them in an *array*—i.e., a list which puts the values in order from smallest to largest (or the opposite). One may determine the difference between the smallest and largest values (the “range”). One may determine a measure of central tendency (such as the mean). One may determine a measure of deviation from the “central” value (such as the standard deviation). One may graphically display the values as a *histogram* (examples of which are presented in Chapter 9). Etc.

Often, in an empirical study, one’s interest is in *comparing columns of values*, to see how one variable varies in relation to a second variable (i.e., “correlates” with that second variable). Various correlation formulas have been created to accomplish such a comparison, each formula designed to “handle” a certain combination of types of values. For example, the well-known [Pearsonian correlation](#) formula (developed by [Karl Pearson](#), 1857 – 1936] is designed to handle values measured on continuous scales (including the absolute scale of counting numbers), and yields a value (*r* value) between -1.00 (a perfect inverse relationship) and +1.00 (a perfect positive relationship), with 0 designating the complete absence of relationship. If, with a given

completed data matrix, a correlation coefficient is determined for each pair of variables, the resulting correlation coefficients can be displayed in a $p \times p$ matrix—which can be thought of as indicating how pairs of variables vary in their relationships. Thus, again we have variation, but now with a different meaning.⁶⁶

A third type of variation associated with the data matrix is *variation over time*. In this case imagine a data matrix with but one row, and the variables being points in, or periods of, time. For example, imagine that a certain type of measurement (e.g., temperature, measured in degrees Fahrenheit) is taken at noon on January 1 for a succession of years, the measurements all applying to the same location. (Were each value to apply to a different location, the set of values would be meaningless.) This is a case where all of the values in a row are of an identical type, thus comparable—a feature not common with data matrices. In this case, the central tendency of the values could be determined (e.g., mean), the standard deviation could be determined, etc. But in such a case it would be inappropriate to go through these operations, as the operation of relevance would be to connect the points on one's graph with a line (perhaps including a "line of best fit").

With a data matrix having *all* values measured in the same units (possibly created via "standardization"), still another sort of variation can be identified. Assume that the observational units are shopping centers, the variables are types of stores, and for each shopping center the "square footage of selling area" has been determined for each type of store. Assume next that *row* totals have been determined, and each row total has been divided into each value in its row. Now, the values in any given row will total 1.00. What we have in effect done is "standardize" the shopping centers; that is, in effect, we have "made" them all the same size (in terms of square footage of selling area), and have done so to enable a more meaningful comparison of shopping centers. The set of values in a given row can now be thought of as indicating the "profile" of the shopping center in question, and we can then compare each profile with each other profile—in this case using a measure of *similarity*, such as the *coefficient of dissimilarity* (or the "normative correlation" formula that I developed several years ago). (This can be labeled an "O-analysis," in contrast with the more typical "V-analysis" referred to above.) Again, as with the correlational analysis referred to above, one can display the resulting similarity coefficients in a matrix, and these numbers can be thought of as indicating how pairs of shopping centers vary in their similarity one with another.

B. Variation: A Broader View

Given the assumption that Darwin's theory of natural election is a theory of monotypic evolution, and not also (or especially) one of polytypic evolution, it is now time to begin the process of clarifying "natural selection" by differentiating between different types of variation. Let me note at the outset here that Darwin's natural selection theory (a) begins by making certain

⁶⁶. Besides "simple" correlation coefficients (involving a pair of variables) there are also "partial" correlation coefficients (showing the relationship between two variables, with other variables "held constant") and "multiple" correlation coefficients (indicating the degree of relationship between a single "Y" variable—one to be "explained"—and a series of "X" ("explanatory") variables), but they are not of interest for the present discussion.

assumptions regarding non-temporal and non-spatial variation, (b) introduces a certain process, which process (“natural selection”) (c) then results in temporal, but non-spatial, variation of a certain sort—i.e., monotypic evolution. The matrix below “locates” monotypic evolution and, by implication, (Darwinian) natural selection in a conceptual framework that enables comparison of it with other types of variation.

		Temporal Variation	Non-Temporal Variation
Spatial Variation		A	Geographical Variation B
Non-Spatial Variation		Monotypic Evolution C	Litter Variation D

Figure 4: Types of Variation

I have not thereby *defined* natural selection, of course. I have merely *delimited* the term somewhat more (beyond asserting that it is a theory of monotypic, but not polytypic, evolution). More definitive “placement” will occur later (in Part Two, Chapter 9).

Variation itself usually involves numerical values; so that when we say of something that it exhibits “variation,” what we mean (at the simplest level) is that (a) numerical values have been determined for units of that thing, and (b) those values differ one from another. The values in question all pertain, of course, to a (i.e., *one*) given variable—so that the values are, in fact, comparable. As the matrix indicates, there can be:

- Non-temporal variation combined with non-spatial variation (the *D* area above)—which is perhaps the most common type of variation encountered in the scientific literature (although not so labeled). The example of such variation especially pertinent for a discussion of natural selection is litter variation.
- Non-temporal variation combined with spatial variation (the *B* area)—e.g., geographical variation, at a given point/brief period of time, in temperature or precipitation (examples of spatially continuous variables, although less so with the latter), geographical variation

in some attribute of a plant species, etc. In these examples the assumption is that reference is being made to a certain point in (or brief period of) time; put another way, the assumption is that time is “being held constant.” Note that a map that uses isolines is a convenient vehicle for describing such variation (e.g., the weather map that uses isotherms to indicate temperature variation—over space—at some given time.)

- Temporal variation combined with non-spatial variation (the *C* area)—e.g., temperature change over time at a given weather station, the stock average as it varies from day to day, etc. Monotypic evolution is, of course, the example of most pertinence here—for I interpret “natural selection” as a process that produces, and only produces, monotypic evolution.
- Temporal variation combined with spatial variation (the *A* area). In real-world terms this sort of variation is common, but is a sort of variation that does not lend itself well to descriptive statements, analysis, and/or depiction. Thus, scientific studies rarely deal with this combination. Models have been created to predict and depict barometric, etc., variation as it varies simultaneously over space *and* time, and we continually see what these models “produce” pictorially as we watch the weather news on television. Special problems are, however, associated with studies that attempt to incorporate both temporal and spatial variation in a single study.

We need not here, though, be concerned with such problems because the only types of variation of relevance for Darwin’s “theory” of natural selection are non-temporal/non-spatial variation (D) and temporal/non-geographical variation (C)—the latter being what natural selection produces, purportedly. Because Darwin recognized the importance of non-spatial/non-temporal variation for his “theory” of natural selection, in the next section I summarize his thinking concerning that sort of variation (as well as non-temporal/spatial variation (B)—i.e., geographical variation.

C. Darwin on Variation

I might note that part of my reason for discussing Darwin’s thoughts concerning *geographical* variation is that *Origin* can be thought of as, in part, a critique of the *naturalist* thinking of his day. In his “Introduction” Darwin noted (p. 4) that “Naturalists continually refer to external conditions, such as climate, food, etc., as the only possible cause of [geographical] variation. In one very limited sense, as we shall hereafter see, this may be true; but it is preposterous to attribute to mere external conditions the structure, for instance, of the woodpecker, with its feet, tail, beak, and tongue, so admirably adapted to catch insects under the bark of trees.” Thus, Darwin was critical of the “conventional wisdom” view that (geographical) variation in a species was explainable solely on the basis of (variations) in “mere external conditions”—and offered his “theory” of natural selection as, not a substitute but, rather, a supplement.

That the fact of variation (non-temporal/non-spatial [lower left quadrant, C], as well as non-temporal/spatial [upper right quadrant, B]) was fundamental to Darwin’s thinking relative to natural selection is indicated by the fact that he devoted three chapters to the topic: Chapter I (“Variation Under Domestication,” pp. 8-37), Chapter II (“Variation Under Nature,” pp. 38-50),

and Chapter V (“Laws of Variation,” pp. 108-39). In summarizing Darwin’s views concerning variation, it will be useful to begin with the D, then B, area of the matrix (Figure 3)

I must preface this summary by noting that not only is Darwin’s concept of natural selection ambiguous; his exposition *per se* is unclear. Thus, it is not always clear what he means in discussing variation. In addition, he did not seem to always use the word “variation” in the same senses that I have done above. For example, on p. 52 “variation” seems to refer to a *value* above the average. And in his use of the word “variations” on p. 108 he seemed to be thinking of a variation as an *individual*—one with a trait(s) differing from the norm (*above* the norm, specifically). But despite difficulties in interpreting Darwin’s meaning, I will attempt to convey Darwin’s thinking concerning variation accurately here.

Logically, the starting point in Darwin’s thinking was the observation that within a given litter there tended to be variability (p. 10): Darwin’s concept of natural selection hinged on the fact that such variability existed. As part of his observation that variability existed at this level, Darwin noted the presence of “monstrosities” (p. 9) and “sporting plants” (p. 10)—i.e., individuals that differed considerably from their fellows. How did Darwin explain this variation? He attributed it to (p. 10) “the laws of reproduction, of growth, and of inheritance”—while recognizing that at the time (i.e., 1859) little was known with certainty regarding heredity. (I should note that shortly after *Origin* was published, Gregor Mendel published—in 1866—the results of his experiments. But Darwin was not cognizant of Mendel’s work—despite the fact that an unread copy of Mendel’s article was found in Darwin’s library after his death.⁶⁷ Indeed, Mendel’s work did not become generally known until 1900, as I noted in the Foreword.)

Although Darwin attributed variation within a litter to the laws of reproduction, growth, and inheritance, he also asserted (p. 9) that “the most frequent cause of variability [within a litter] may be attributed to the male and female reproductive elements having been affected prior to the act of conception.” What he seemed to be saying here was that (what we would call) mutations occurred in the genetic material of one or both parents, and that this caused the variability. The term “gene” had not, of course, been coined yet;⁶⁸ but Darwin seems to have come close to thinking in terms of genes.⁶⁹ At a later point in *Origin* Darwin asserted (p. 108) that “the reproductive system is eminently susceptible to changes in the conditions of life” Thus, he attributed changes in the “reproductive system” to changes in “conditions of life,” but failed to make clear precisely what he meant by “reproductive system” and “conditions of life.” It

⁶⁷. Robin Marantz Henig, *The Monk in the Garden: The Lost and Found Genius of Gregor Mendel, the Father of Genetics*. Boston: Houghton Mifflin Company, 2000, p. 143.

⁶⁸. Danish botanist Wilhelm Johannsen coined the term “gene” in 1909. Ruth Hubbard and Elijah Wald, *Exploding the Gene Myth*. Boston: Beacon Press, 1993, p. 42.

⁶⁹. Maitland A. Edey and Donald C. Johanson have pointed out that Darwin speculated about “[gemmules](#)”—i. e., particles of influence within the individual. Thus, Darwin speculated about the existence of gene-like units several decades before genes were discovered. Maitland A. Edey and Donald C. Johanson, *Blueprints: Solving the Mystery of Evolution*. Boston: Little, Brown and Company, 1989, p. 185.

appears, however, that Darwin was thinking in Lamarckian⁷⁰ terms here (i.e., the inheritance of acquired characteristics).

Not only did Darwin insist that variation in a litter was explainable on the basis of the laws of inheritance—whatever they were. He insisted that (p. 13) one should regard “the inheritance of every character whatever as the rule, and non-inheritance as the anomaly.” That is, one should assume that an individual had his/her particular characteristics because s/he had inherited them from his/her parents until, and unless, some other explanation is not only offered, but established. But beyond this, one should reject the Lamarckian view that *acquired* characteristics can be inherited (a view he explicitly rejected on p. 111—but seemed to embrace on p. 108, as I noted above). Thus, not only did Darwin reject (to a degree, at least) the view, common to naturalists of his time, that the attributes of individuals reflected “conditions” (arguing instead for the primacy of inheritance); he rejected (in places, at least) the Lamarckian theory that *acquired* (physical—and also behavioral?) characteristics can be inherited. (And, I should add that in arguing for inheritance Darwin also believed that *sexual selection* was a mechanism that could explain certain variations; e.g., on p. 74 he argued that this mechanism explained male/female differences within a given species.)

Darwin did, however, believe that the (behavioral) “habits” that an individual had *acquired* could affect his/her physical characteristics—and that those acquired characteristics could be transmitted to progeny (p. 110). Regarding ducks, for example, Darwin stated (p. 11) that “I find in the domestic duck that the bones of the wing weigh less and the bones of the leg more, in proportion to the whole skeleton, than do the same bones in the wild-duck; and I presume that this change may be safely attributed to the domestic duck flying much less, and walking more, than its wild parent.” Thus, although Darwin ostensibly rejected the (Lamarckian) theory that an acquired *physical* characteristic could not be inherited, he accepted the (seemingly similar) idea that if a physical characteristic was the result of *habitual behavior*, it could be inherited—that *use/disuse* of an organ affects the transmissibility of the organ (see pp. 110-14). Evidently, Darwin believed that if a physical characteristic resulted from a “mutilation” (p. 111), it could not be inherited; if, though, it resulted from use/disuse, it *could* be inherited. Given these various statements on inheritance, then, it is difficult to ascertain *what* his real beliefs were, because he continually made contradictory remarks.

Oddly, although Darwin knew that members of a given litter would vary, and he attributed this variation to inheritance, he simultaneously seemed to accept the then-popular “blending” (or “fusion”) theory of inheritance (e.g., p. 14)—the idea that characteristics of parents would be “blended” in offspring. In 1867 Henry Charles Fleeming Jenkin [1835-1885], an engineering professor at Edinburgh University (and close friend of Lord Kelvin), pointed out, in a lengthy review of *Origin*, that under Darwin's assumption of blending inheritance, natural selection probably cannot modify the “mean species type”—as Darwin evidently thought it would.⁷¹ That

⁷⁰ Named for Jean Baptiste Pierre Antoine de Monet, Chevalier de Lamarck [1744-1829].

⁷¹ Jean Gayon, *Darwinism's Struggle for Survival: Heredity and the Hypothesis of Natural Selection*. Cambridge, UK: Cambridge University Press, 1998. See Chapter 3, “Jenkin's Objections, Darwin's Dilemma,” pp. 85-102

is, Jenkin pointed out that the blending theory was incompatible with what Darwin thought natural selection would produce (i.e., slow, steady, progressive change). Jenkin asserted that “the rate of variation in a given direction is not constant, is not erratic; it is a constantly diminishing rate, tending therefore to a limit.”⁷²

The fact of variability in a litter was an important one for Darwin because it helped him explain why breeding (“artificial selection,” p. 161) is successful. For breeding to occur, individuals of a species must vary (p. 33). The breeder then selects an individual having a desired physical or behavioral trait, and mates it with a similar individual of the opposite sex. Of the progeny produced (which will vary), the breeder selects, for survival, the one(s) with the desired trait, and (perhaps) kills the rest. He then raises that individual(s), and breeds it with a similar individual of the opposite sex when it reaches maturity. That trait will then “accumulate” (p. 5) over time. That is, there will be *directionality* with the given trait—there will be slow, steady, progressive change in the given trait over time—along with other traits that are correlated with it (p. 12). Darwin added that (p. 26) “One of the most remarkable features in our domesticated races is that we see in them adaptation,^[73] not indeed to the animal’s or plant’s own good, but to man’s use or fancy.” That is, breeders do not tend to make their species more “fit” for the environment (domesticated individuals often being provided with an artificial environment anyway); rather, animals are bred for certain *human purposes*.

Darwin pointed out (p. 35) that “A high degree of variability [in a litter] is obviously favourable, as freely giving [the breeder] the materials for selection to work on . . . [and thus] to allow of the accumulation of a large amount of modification in almost any desired direction.” He also seemed to suggest (p. 92) that two different breeders could each select an individual from a given litter, and each develop a different variety from that litter. *This fact may help us understand why Darwin did not distinguish between monotypic and polytypic evolution: Evidently, Darwin believed that a process (i.e., natural selection) operated in nature analogous to what would happen with breeders, in that the process could result both in a given species changing and new species arising from existing ones.*

At the beginning of Chapter I Darwin noted (p. 8) that individuals of a domesticated variety “generally differ more from each other than do the individuals of any one species or variety in a state of nature.” Oddly, though, he explained the “great variability” associated with the former by asserting that it “is simply due to our domestic productions having been raised under conditions of life not so uniform as, and somewhat different from, those to which the parent-species have been exposed under nature.” More plausibly, however, it would seem that the greater variability associated with a domesticated variety would reflect *breeder activity*—which (often) makes individuals of a variety neither more nor less fit for a given environment. In explaining variation with a variety in a state of nature, on the other hand, one would expect that

⁷². Quotation from Jenkin’s review of *Origin*, which appeared in *The North British Review*, June 1867, Vol. 46, pp. 277 - 318. I have quoted from the electronic text of the article, prepared by Ian Johnston: <http://records.viu.ca/~johnstoi/darwin/jenkin.htm>.

⁷³. Note Darwin’s use of the word “adaptation” here, whereas some other term would have been more appropriate.

varying *physical* conditions would “explain” variations in individuals—for one would expect that (environmental) “fitness” would be maintained from place to place. Given that one has no such expectation with a domesticated variety, one would not expect variation in physical conditions to be reflected in variations in individual characteristics with domesticated varieties. Rather, variations in a domestic variety would simply reflect breeder activity⁷⁴

It is, though, difficult to compare a domesticated variety with its “wild” counterpart. For the variable(s) which confers survival value on a wild individual in a state of nature may not be of interest to breeders. For example, coloration may be the determining variable in the survival of wild individuals of a given species, but breeders may ignore that variable and develop the species in a direction—i.e., on the basis of a variable—that is unrelated to coloration. And individuals with the “wrong” coloration for survival in the wild may, in the hands of breeders, be enabled to survive because it is *breeders* who are determining which individuals survive, not, e.g., individuals of a predator species.

On p. 10 Darwin not only noted that individuals of a litter can vary greatly, but went on to add that this was the case even though they “have apparently been exposed to exactly the same conditions of life” He then concluded that “this shows how unimportant the direct effects of the conditions of life are in comparison with the laws of reproduction, of growth, and of inheritance” What Darwin failed to recognize here is that a given phenomenon can be studied at different geographic *scales*, and that a variable important (as an explanatory factor) at one scale may not be important at another scale—because it is a *constant* at that scale, and constants have no causal efficacy. At the scale of a very small area, within which there is environmental homogeneity, the environment plays no causal role, precisely because it is a *constant* at that scale. At a regional scale, however, the environment would be expected to vary significantly geographically, and to be an important factor influencing geographical variation with a species. There is, in fact, no contradiction in saying that a variable may have explanatory value at one geographical scale, but lack such value at another geographical scale—a fact that Darwin seemingly failed to recognize.

At any rate, this brings us to the matter of Darwin's discussion of *geographical* variation. Darwin (referring to Augustin de Candolle, 1778-1841) noted (p. 45) that a (plant) species with a wide range generally “presented” geographical variation to the degree that different varieties of the species could be identified. He explained this variation by referring to variations in “physical conditions,” but then added that another reason was that members of the given species “come into competition (which . . . is a far more important circumstance) with different sets of organic beings.” Darwin failed to make clear, however, what role competition with other “organic beings” might play in affecting geographical variation in a given species. His point here is certainly a believable one, but Darwin failed to provide it with proper support.

Indeed, Darwin's views regarding geographical variation *per se* are not at all clear. For example, on p. 115 he stated that “each species is adapted to the climate of its own home,” but in the very next sentence declared that “the degree of adaptation of species to the climates under which they live is often overrated.” And on p. 324 he referred to “the deep-seated error of considering the

⁷⁴ The “expectations” to which I refer should perhaps be ones that we moderns might have, but that Darwin did not have: we have much more information available than Darwin had.

physical conditions of a country as the most important for its inhabitants . . .”—important, presumably, as a factor explaining spatial variation in a species.

On p. 283 Darwin stated: “The dissimilarity of the inhabitants of different regions may be attributed to modification through natural selection, and in a quite subordinate degree to the direct influence of different physical conditions.” Two things should be noted here. First, he now claimed that natural selection explained geographical variation in a species—but failed to indicate *how*. Second, he referred to the *direct* influence of “physical conditions.”

It is not clear how the environment would *directly* influence a species, for we usually think of its influence *as indirect*: The environment is something to which a species *adapts* (i.e., from a long-run standpoint, adaptation occurs by the survival of those who fit the environment, and the non-survival of those who do not fit⁷⁵). Darwin may have been correct in stating that the environment has little *direct* influence (whatever that means), but the point is that the environment clearly *does* have a significant *indirect* influence. Darwin, however, chose to downplay the importance of the environment—a fact that many seemingly fail to recognize (perhaps because the phrase “survival of the fittest,” as usually used, *seems* to refer to fitting the physical environment, but does not—as we shall see later, in Chapters 8 and 9).

In discussing comments made by Darwin in *Origin* on variation I have, perhaps, “gotten ahead of myself” somewhat. I believe it of value, however, to have inserted this “sidebar” on Darwin’s views regarding variation, to give the reader an opportunity to compare his views with the (more abstract) ones that I offered earlier.

⁷⁵. I should add that a species may adapt to a *changing* environment by migrating! This option is, of course, most open to species with mobility.

Chapter 5: The Nature of Explanation

An “explanation” can be thought of as a statement (or series of same) designed to answer the “Why?” (or “How?”) question. Usually, intentions (or goals) on the part of the (human) actor (in the case where the objective is to explain the actor’s behavior) are not thought of as explaining the actor’s behavior. For usually a “scientific” explanation is thought of in deterministic terms— as citing causative factors that *preceded* the behavior to be explained (or were contemporaneous with it), and intentions do not qualify because they refer to a future state that antecedes the behavior that one wishes to explain. One can very well argue, however, that if one’s “subject” is human behavior, it makes perfect sense to assume that although behavior may be partly determined (i.e., explained on the basis of preceding or contemporary “causes”), what distinguishes humans from other life-forms is the capacity to have, and act on, intentions.⁷⁶

If there is a tendency to think of human behavior in deterministic terms, what this may reflect is the fact that the concept of explanation still dominant is one developed for applicability in the “hard” sciences such as Physics and Chemistry. Once scientific thinking came to be applied to, e.g., biological phenomena, it was natural for the concept of explanation associated with the hard sciences to be used initially; but that as the peculiarities of the subject matter became more evident, modifications were forthcoming in the approach used for explaining (e.g., the systems concept, associated with [Ludwig von Bertalanffy](#) [1901 – 1972], was developed). And that still further modifications came into existence as scientific methods came to be applied to the study of humans. Still, it is questionable whether an adequate conceptual framework yet exists (with corresponding methodologies) for the study of humans and their behaviors.

This latter fact need not detain us here, however, for the concept of explanation to be discussed here is appropriate for the subject matter at hand. Given this, in discussing explanation I first discuss explanation as that term is used in statistical studies (ones that would have their basis in data matrix values, per those presented in Chapter 3). Then, I discuss an older concept of explanation, what I call the “philosophical” concept of explanation⁷⁷—because it was developed by philosophers (of science, in particular). The two concepts of explanation are different, but not contradictory; in fact, I think of the statistical concept of explanation as being an “operational” version of the philosophical concept.

⁷⁶. See Nathaniel Branden, *The Psychology of Self-Esteem*. Los Angeles, CA: Nash Publishing Corporation, 1969. This book does an excellent job of defending the (obvious) fact that humans are not merely *driven* by causes but also *pulled* by the effects that they anticipate as a result of their actions. Please note that in praising a book by Nathaniel Branden, I do not mean to be expressing an admiration for [Ayn Rand](#) (1905 – 1982), a woman with whom Branden was romantically involved for a time. Indeed, I have no admiration for her whatsoever—and in that respect am somewhat “out of tune” with my age (here in the United States, at least). But being “out of tune” is not something that bothers me in the least!

⁷⁷ My thinking on this has been especially influenced by Richard Bevan Braithwaite, *Scientific Explanation: A Study of the Function of Theory, Probability and Laws in Science*. Cambridge, UK: Cambridge University Press, 1968.

A. Statistical Explanation

In discussing types of variables in Chapter 3 a distinction not referred to in that discussion is that between *dependent* variables and *independent* variables. Now, I can point out that commonly an empirical study will have as its objective a multiple correlation-regression analysis—the purpose of such a study being to “explain” variations of the “dependent” variable on the basis of variations in a series of “independent” ones. This involves selection of a variable to “explain” (the dependent—or *Y*—variable), the selection of explanatory variables (independent—or *X*—variables), the collection of data and, finally, the “running” of a multiple correlation-regression analysis (using a computer). Such an analysis results in obtaining a “multiple correlation coefficient” (an *R*, a number varying from 0 to +1.00), along with a regression equation. The latter uses *X* values in conjunction with parameters resulting from the “run” to “predict” *Y* values. The running of a multiple correlation-regression analysis not only indicates to the researcher *how well* the independent variables “explain” the dependent variable, but how *important* each independent variable is in explaining the dependent variable (i.e., the “explanatory power” of each independent variable).

Darwin’s *Origin* did not, of course, involve use of statistical procedures, as such procedures had not yet been developed (and computers were still far into the future). *Origin* did, however, involve explanations, most notably his “theory” of natural selection. And the type of explanation associated with *Origin* is related to statistical explanation in the sense that the latter has its philosophical derivation from the sort of explanation associated with *Origin*. Still, the concept of explanation associated with *Origin* is “pre-statistical,” and is the sort of explanation of especial interest to philosophers of science, including now.

B. Philosophical Explanation

As a work such as the classic book by Morris R. Cohen and Ernest Nagel⁷⁸ clearly indicates, an important difference between the various sciences is that each has its own notions regarding what constitutes an acceptable explanation. Still, likely the dominant concept of what constitutes a proper explanation is the “covering law” concept. Fortunately, it appears that Darwin used (if not very well) that concept of explanation in his *Origin*; therefore, it is appropriate here to discuss that concept of explanation, in cursory fashion at any rate

The covering-law concept of explanation is statement-oriented in that it sees explanations as consisting of *statements*. The statements involved may be verbal ones, but need not be: They may, e.g., be mathematical statements—and increasingly, indeed, are assuming that form. But whether they are verbal or mathematical, the statements comprising an explanation (of the type under discussion) can be thought of *descriptive* statements, and as arranged in a certain order, namely a *logical* order. More specifically, the *explanandum* statement is always the last statement, and the *explanans* statements always precede the *explanandum* statement. (Note here that the former is always singular, the latter always plural.) Although with the statements

⁷⁸. A currently-available edition of the work in question is *Introduction to Logic and Scientific Method*. San Diego, CA: Simon Publications, Inc., 2002.

comprising the *explanans* there may be no strictly logical order, one order may be preferred over the others—one reason being that some of the statements comprising the *explanans* may actually be logically derived from statements above them, so that they are *explananda* within the *explanans*!⁷⁹

I need to also add, regarding statements within the *explanans*, that at least some of them are normally considered to be “laws”—i.e., “true” *universal* statements. This is why, of course, this sort of explanation is referred to as a “covering-law” explanation. Also, *first-stage* explanations can be distinguished from *second-stage* ones in that the former has an *explanandum* that is a time- and space-bound fact (ideally is “true,” at least, however!), the latter has as an *explanandum* a law (or limited generalization, I would add).

From what I have said so far regarding covering-law explanations it should be apparent that it is the *explanans* statements which “explain;” they “explain” the *explanandum*—and do so by “producing” (or “predicting”⁸⁰) the *explanandum*. That is, the *explanandum* is “explained” by virtue of the fact that it is logically deducible (or derivable) from the statements comprising the *explanans*. A caution that should be added here, however, is that although a given *explanandum* may be “produced” by a given *explanans*, it is always possible that it could *also* be “produced” by *another explanans* (i.e., another set of statements). This fact means that there is always potential disagreement between scientists as to the appropriate explanation of some given *explanandum*, and there may be no reasonable way to resolve their disagreement. (A “happy” way of resolving the problem, however, is to argue that one *explanans* is appropriate in one context, another *explanans* in another context.)

In the Foreword I mentioned that a distinction can be made between “theory” and “model;” this, then is a good point to discuss that distinction. I will contend here that the word “explain” suggests that the *explanandum* in question has been firmly established, and that the explanation itself should be labeled a *theory*. The word “predict,” in contrast, suggests that a *model* is involved, and that its *explanandum* has the character of a hypothesis, rather than a law. Figure 5 below indicates why I believe it important to distinguish between the two. What it illustrates is that in the case of a theory, the starting point is an established law (or limited generalization). That is the *explanandum* exists before the theory is created, and the *explanandum* is well-established. One’s research begins with an established law or limited generalization, and one’s next step is to identify the factors that one believes are relevant in explaining this law/limited generalization, and then create a statement for each of those factors. One next determines whether or not this law/limited generalization can be deduced from those statements. If it can be, one may cease one’s research, given that one has “explained” the *explanandum*. One should,

⁷⁹ I should note here that the “neatness” that I attribute to explanations here—in the separation of *explanans* from *explanandum*—is one that I violate in my “translation” presented at the end of Chapter 8!

⁸⁰. Although commonly “prediction” is thought of in temporal terms (i.e., as referring to a future state or situation), in science the term typically has no such connotation. Thus, “explain” and “predict” have virtually the same meaning for most scientists, especially in the context of “statistical explanation.”

however, keep in mind that some other set of statements (*explanans*) could, conceivably, explain the *explanandum* as well—or even better.

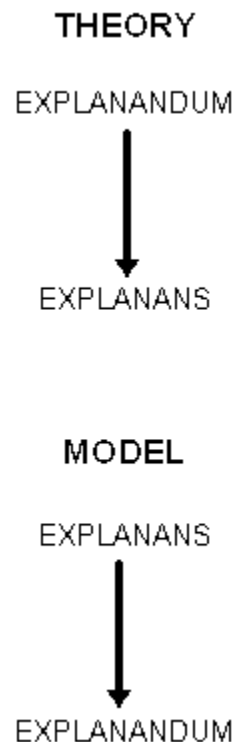


Figure 5: Differentiating Theory and Model

If a *model* is created, the implication is that an *explanandum* does *not* exist at the beginning of one’s research; rather, insofar as an *explanandum* exists, it is simply a “hunch” as to what might exist. That hunch, however, forms the basis for the model that one then creates—by identifying causative/explanatory factors that one believes may be involved, creating a statement(s) for each factor, and then determining what the model predicts. Having that prediction in hand, one then compares it to relevant real-world data. If the model has predicted well, one can say not only that one has *predicted* real-world data well, but has *explained* it as well.

How does this distinction become relevant for a discussion of Darwin’s natural selection “theory”? Darwin began his research, not with solid information as to how species change over time but, rather, with information regarding what happens with breeding in conjunction with a conclusion (intra-specific competition resulting from “excess” births derived from Rev. Thomas [Malthus](#)’s “law” of differential growth (of population and the expansion of food supply)). Given this, the *explanans* that he created is more properly thought of as a model than a theory. And given *that*, the logical next step for him after creating his model, and deriving from the statements constituting his *explanans* the “fact” that change would occur in a slow, steady, progressive manner, would have been to compare that prediction with data for real-world species. If, upon finding that the model didn’t predict well, that should have motivated him to modify his model substantially—or even discard it, and start over. Darwin did not do this,

however, in part because he may have been entranced with his “theory,” but in larger part because he lacked the real-world data to which to compare his model’s prediction(s).

If Darwin’s early critics did not criticize Darwin’s model for failing to predict well, this was because they, also, lacked the real-world data for so doing. However, as evidence began to accumulate regarding how species in the wild changed over time (as a result of research by geologists)—so that the “punctuated equilibria” hypothesis could be formulated, and more and more evidence gathered (to a point that some, including myself, would regard it now as a law)—it became more and more clear that Darwin’s model was a very poor predictor. As a consequence, by 2000 it should have been sufficiently clear that Darwin’s model should be discarded, with attempts to produce, now, a theory to explain the law of “punctuated equilibria.”

A theorist intent on developing a theory to explain the punctuated equilibria law would, first, need to know the nature of that pattern—long periods of stasis followed by brief (from the standpoint of geological time) during which some species became extinct and other species “spawned” new species. That is, the pattern was one of polytypic evolution, and a virtual absence of monotypic evolution. Second, this pattern seems to be correlated with geological events in that the periods of speciation and extinction have been correlated rather well with periods of geological upheaval. Given this correlation, the suggestion is that something associated with these periods of upheaval was either causing the biological events, or causing the causes of those events. The problem, then, would be to identify that factor(s), and then derive for that factor(s) statements such that, taken collectively, they would “produce” the real-world pattern. If such a theory already exists, I have never encountered it.

Having now given attention to several methodological topics that are related to a discussion of Darwin’s natural selection theory, we are now in a position to determine, as precisely as we can, the meaning of “natural selection” as used by Darwin (Chapter 8), after which we can critique the theory (Chapter 11) and, finally, address other topics of interest—such as its lack of relevance, both for explaining the evolution of humans, and providing a “scientific” basis for Social Darwinism. The two initial chapters of Part Two, however, are devoted, first, to (Chapter 6) a speculative account of the development of Darwin’s comprehensive theory, followed by (Chapter 7) a presentation of that theory (actually, “model” would be a more apt term).

PART TWO: CLARIFYING AND CRITIQUING DARWIN

Chapter 6: The Origin of *Origin*: A Speculative View

I stated in the Foreword that I have come to perceive the theory (model actually) that Charles Darwin offered to explain “descent with modification”/“transmutation” as tripartite, consisting of a “macro” part (with two subparts—one concerned with geographical variation, the other with extinction), and a “micro” part (change, over time, in a given species—i.e., by natural selection). My objective in this short chapter is to offer a speculative view as to how Darwin arrived at this model. For the “macro” parts my sources of information/inspiration are Darwin’s Galápagos experience and the “diagram” discussion in *Origin* that begins on p. 96 (within Chapter IV—for the *geographical variation* part) and scattered references in *Origin* (e.g., pp. 6, 72, 90, 92, 256, 257) for the *extinction* part. The “micro” (natural selection) part draws from throughout *Origin*, but especially chapters III (“Struggle for Existence, pp. 51 – 66) and IV (“Natural Selection,” pp. 67 – 107).”

It is doubtful whether Darwin’s name would have much recognition today had he not been aboard the *HMS Beagle* (from late 1831 to late 1836), captained by Robert FitzRoy [1805 – 1865], just a few years Darwin’s senior. This trip gave Darwin a unique opportunity to observe, collect specimens, think, and make notes. And although Darwin began and ended the trip believing in the fixity of species, as he reflected on what he had observed upon his return to England, his thinking began to change on this matter. While in the Galápagos, he had observed how relatively isolated (from one another) islands exhibited different varieties of the same species, but had not really noticed it. It was only upon his return to England that it occurred to him that this variation was explainable on the basis of the differing environmental conditions of the different islands. That is, a naturalistic explanation could be advanced for this variation; there was no need to resort to a *supernaturalistic* one.

But *how* could one explain the variation in species within a given small area? The environment would act as a “constant” in such a situation, and therefore could not explain that variation. And how could one explain variation in the species-content of a given area over *time*? Certainly migration could help explain such variation, but what if there weren’t any migration? Would that mean that there would be no species change in a given area? How, then, did the various species in a given area get there, if not via migration? The popular explanation was that they had been created by God, had been created for a particular niche in “the economy of nature,” and remained fixed in character over time. But how did one explain, then, apparent fossil evidence of the existence, at some time in the past, of species no longer existing? If there were a naturalistic explanation that could easily explain *why* a species varied from one island to another—the *species itself* (not individuals *per se*) had adapted to varying environmental conditions—is it not conceivable that there is also a naturalistic explanation that accounts for these other puzzling matters?

From what we know regarding the taxonomic work of people such as Carl Linnaeus, life-forms exist at many different degrees of complexity, from the very simple to complex ones such as humans (although humans so often seem not to use the brains they were born with!). And from what we know from the work of geologists, as we go farther and farther back in time, there

seems to be a general tendency to encounter ever simpler forms of life. Isn't it, then, at least plausible that earlier and simpler forms of life had given rise somehow to other more complex ones? Certainly the reverse is not plausible: It is believable that the complex builds on the simple—something we know simply by studying human history; it makes no sense to believe that the simple would emerge from the complex.

Others before me (“speaking” now for Darwin)—including my grandfather Erasmus—have speculated that life is a dynamic thing, with new species emerging from existing ones, so that my line of thinking here is not novel. The problem with those who have thought about this matter in the past, however, is that they have been unable to arrive at a convincing explanation of just *how* and *why* this process occurs. My task, then, is to find that explanation—and so far the only “piece of the puzzle” that I have is that I have a fairly good understanding of how and why different varieties of a given species arise—how and why, in fact, different *related* species can arise.

These are the sorts of thoughts that, I suspect, went through Darwin's head after his return to England, and even toward the end of his trip. Apparently he began to think (or at least sense) that the study of breeding activity might help him arrive at answers, so he began to associate with individuals engaged in that activity, began “reading up” on the subject, and even began himself to engage in (pigeon) breeding. From this study he learned that a breeder could take a few individuals of a species that had a trait that he wanted to develop, and from that small group develop a variety that had the trait(s) that he wanted. Another breeder living in the same area (with, thus, the same environmental characteristics) could also take a few individuals from that same species and develop from those individuals a variety having a trait(s) that *he* wanted—that trait(s) being rather *different* in nature from the one associated with the first breeder. What the two breeders would have in common, however, was that their efforts in bringing about change were slow, but also steady, and progressive—because the whole point of the breeding efforts was to bring about change in a certain desired *direction*.

Was there, wondered Darwin, a process operating in nature that would also bring about change? And given Darwin's conviction that the change in life-forms on earth had been of a progressive nature—from simple life-forms to ever more complex ones (as the *trend*, at any rate)—specifically was there a process operating in nature that would produce change that could be thought of as *progressive*?

His recent reading (or memory of a past reading) of Rev. Thomas R. Malthus's [1766 – 1834] *Essay on the Principles of Population* (first published in 1798) seemingly provided him with the answer that he was seeking (and provided Alfred Russell Wallace—half a world away—with virtually the same answer, and at virtually the same time!). Malthus had asserted as a “law” that human population tends to grow at a more rapid rate than does food supply (geometric vs. arithmetic rate), and that certain consequences were associated with that “fact”: Many would be forced to live without an adequate supply of food, and thus in misery; because this situation was inevitable (i.e., most could not be educated to reduce their number of progeny), charity was doomed to failure. Therefore, it was foolish for one with means to engage in charitable acts because that would simply help perpetuate a vicious cycle.

What Darwin saw in this “law,” however, was not its implications for how one should relate to one’s *fellow human beings* but, rather, something that Malthus had not recognized. Darwin accepted Malthus’s “law” of excess births (relative to a given area’s carrying capacity) and, indeed, accepted it as a law that applied to all life-forms, not just humans. He then reasoned that for any given species this would result in a “struggle for existence” by members of that species: If a “surplus” is created, by definition a number equal to that surplus must somehow “go away” because the area’s carrying capacity is limited and fixed. Darwin evidently dismissed the possibility that some could escape starvation by *migrating* by assuming that the world was already “fully stocked,” so that there was nowhere to go. Thus, given that individuals of a given species were “trapped” where they were, their only “choice” was to compete with their conspecifics for the available food.

This was a crucial conclusion on Darwin’s part, for Darwin assumed—realistically—that the individuals of a given species in a given area would, for an array of variables, vary in the degree to which they had that characteristic. Although the “position” that a given adult had on a given variable might reflect not only that individual’s heredity but his or her experiences/activities, such would not be the case with the just-born: The just-born had not had any experiences (if one excludes experiences while in the womb), so that their characteristics solely reflected the genetic nature of the parents. Given that all just-born were “on their own” from birth (Darwin assumed, tacitly), they would have the least advantage in competition with conspecifics for food, so that few of them would be expected to survive. Some would, however—for the mere fact that the species exists is proof of that. But which ones would be expected to live, which die?

The answer here will vary from species to species, because the question to be answered is: For the given species, what trait(s) will give an individual an advantage in competition with conspecifics? That is, what is the “success” trait(s) for that species? Is it speed? Elusiveness? Strength? Coloration? Whatever that “success” trait is, those individuals born with the most of that trait(s) have the advantage in winning against conspecifics—and “winning” means living, “losing” means dying.

With this process occurring year after year with a given species, if for each of a succession of years one determines the mean value for the “success” trait(s) and writes these values down, one will observe that the mean for one year tends to be slightly larger than it was for the previous year. If one then graphs these means, with “time” on the X axis and “success variable” on the Y axis, representing each year on the graph with a dot (or “x,” etc.) and, finally, draws a “line of best fit” through this “cloud” of dots, one will observe that the line is an upward-sloping one. That is, what has occurred here is that one has evidence that the species in question has changed over time. In fact, not only has it changed; it has changed in a *progressive* manner! Two qualifications are in order, however. First, the change has only been of a *quantitative* nature. Second, the change has only been in the “success” variable—plus any other variables that happen to be highly correlated with that variable.

Will the change that one has observed “go on for ever and ever”? That is, is there no limit to the amount of change that can be expected to occur? Evidently Darwin’s view here was that in the case of breeding, ever more “progress” was made over time so that, given this, in the case of nature, because the time span was much, much longer, there was no reason to think that much

more change could not occur—easily to the extent that new species could come into existence. Certainly Darwin’s “tree diagram” discussion (p. 96 ff.) suggests as much. However, there are two problems with this conclusion that can be mentioned at this point. First, it assumes that there are no biological limits to change. For example: “[Luther Burbank](#) [1849 – 1926], perhaps the most famous breeder of the twentieth century, says that in all his years of practical experience, he came to realize that, in regard to breeding, there is an incessant law always at work that constrains and limits the extent of variations possible within a species.”⁸¹

Second, assume that the “success” trait is one that would be measured on a nominal scale and that, in fact, dichotomization is used. In this case, if one has the trait, one survives, if one lacks the trait, one dies. Under these assumptions, if for a given year one now determines the percent of individuals with the trait, it will be 100. In fact, it will be 100 *every* year—so that one’s “line of best fit” will be parallel with the X axis. That means, of course, that no progress is evident from year to year—because the assumptions have been such as not to allow any! In a breeding situation, of course, the expectation is that if one desires to achieve 100 percent possession of some trait—which, note, would be a “success” trait in a *non-survival* sense—one would not have (obviously) have that value at the beginning. Rather, the first year the percent might be 50, the second year 62, third year 76, fourth 84, fifth 92, sixth 96, seventh 99, eighth 100.

Darwin, however, evidently thought—on the basis of breeding experience—that it was reasonable to project from that experience that because nature had a vastly longer period to effectuate change in species than humans do with breeding, that nature could “accomplish”—via this process of what he called “natural selection” (because of its parallel with the “artificial selection” of breeding)—a degree of change such as we can observe in the world. After all, had not Cambridge Professor [John S. Henslow](#) [1796 – 1861]—the man responsible for his *Beagle* voyage—identified several of the specimens that Darwin had sent back to England as being separate species of finches? So that there was good reason to believe that over a fairly short period of time, in the Galápagos several species of finches had developed in response to a combination of environmental adaptation and natural selection?

At any rate, Darwin believed that he could now explain how the various life-forms had developed. And although learning about Wallace’s work must have thrown him into a panic, it must also have assured him that he had, indeed, found the answer. In the next chapter, then, I summarize what I take to be Darwin’s comprehensive model.

⁸¹ Jeremy Rifkin, *Algeny: A New Word – A New World*. New York: Penguin Books, 1984, p. 131. First published by The Viking Press, 1983.

Chapter 7: Darwin's Comprehensive Model

Although the previous chapter made no reference to extinction—one of the three components of Darwin's comprehensive model of evolution—the previous chapter can be thought of as providing the intellectual backdrop for this chapter, in which I present a model based basically on the content of Chapter 6. The model that I present has as its “setting” a hypothetical area, depicted in Figure 6:

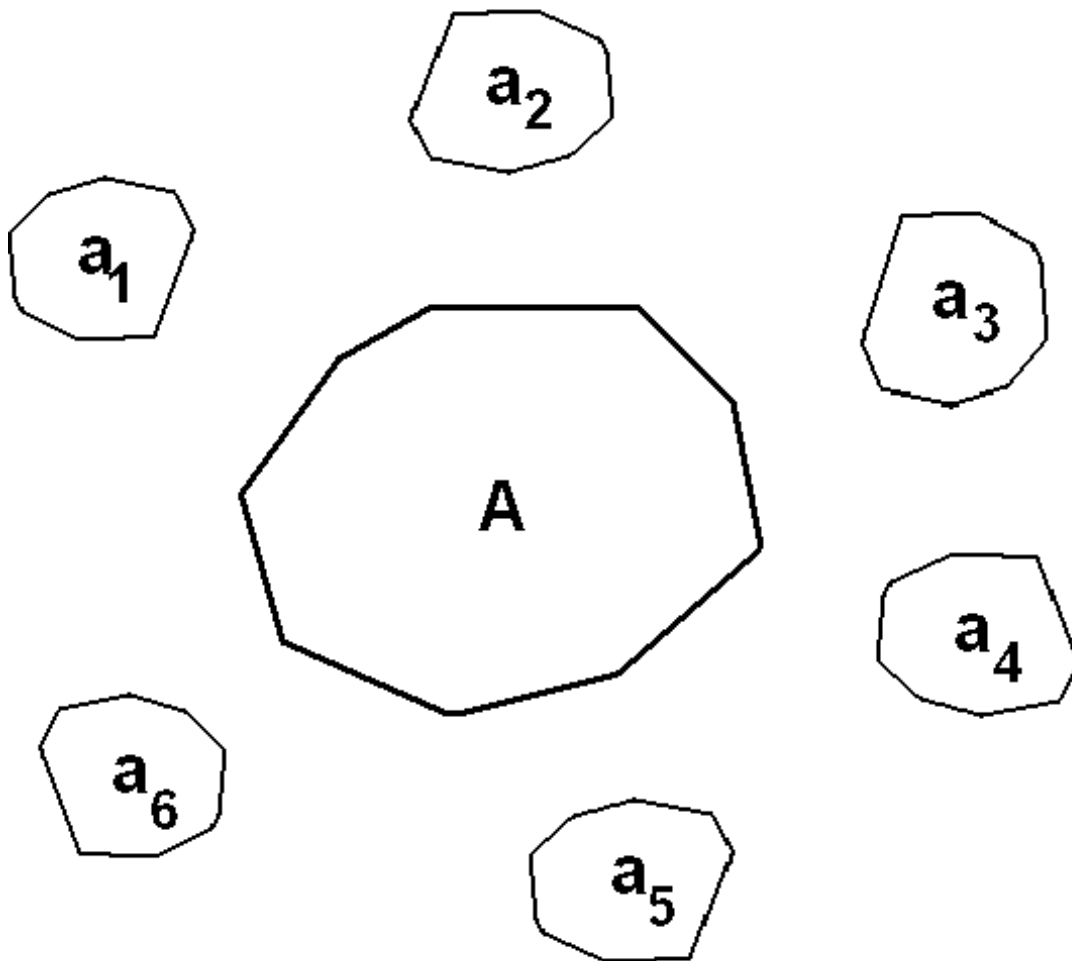


Figure 6: Area and Six Subareas

We begin by assuming that area A is occupied by (among other species) Species A, and that it occupies that area at a carrying capacity level. We also assume a Malthus-type situation in that more are born than can survive. We also assume that all individuals of the species are “on their own” from birth, but initially assume that the excess births do not precipitate intra-specific

competition. Rather, we assume the operation of two mechanisms that reduce the population to a carrying capacity level. First, the just-born are assumed to vary in how well they are adapted to the environment of area A: Those that are adapted live, those not adapted die. Adaptation can be depicted graphically as follows:

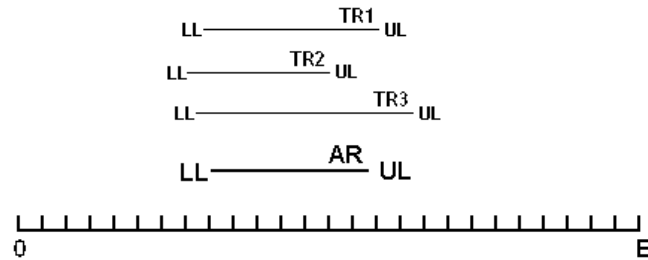


Figure 7: AR and TR

The assumption here is that the various elements of the environment can be “collapsed” into a single variable, E . The AR (for Actual Range) line indicates for area A the upper and lower limits of E experienced in area A during the course of a given year; this includes not only diurnal changes in E value, of course, but seasonal changes as well. The three TR (Tolerance Range) lines represent individuals of the species, indicating the tolerance range of each. Note that they vary in length and position relative to the scale and AR line. If, for a given individual, the TR line’s LL (Lower Limit) *and* UL (Upper Limit) extend beyond that of the AR line, that individual can survive in area A; otherwise, the individual will die. In Figure 7 Individuals 1 and 3 were born with TRs satisfying the requirement for living, and are therefore able to survive, *ceteris paribus*. Individual 2, however, will not be able to survive for the entire year. Depending on the season of birth, Individual 2 may die immediately, may die after a few months, or may not die until near the end of the year—but will die. The assumption here, of course, is that reference is being made just to the just-born, and that the only factor causing premature deaths is failure to have a TR that will enable the individual to adapt, and therefore survive. In addition to deaths of the just-born there will also be deaths from “old age,” but these can be ignored because they have no biological consequence: The individuals involved have already produced progeny (*if* they have).

Other than “old age,” the deaths that our model involves, then, are deaths of the just-born, first, as a result of not being born with a TR that would enable survival. Such deaths (along with “old age” deaths) might not, however, be sufficient to bring the population down to a carrying capacity level, and so we must introduce another mechanism to help complete this task with the just-born. What shall it be? Let us assume that a *random sample* of the just-born are unable to acquire a sufficient amount of food to live, and therefore die.

We now have processes in operation that will ensure that the population size will remain stable. Note that we assume that the birth rate remains constant, and that the “old age” death rate also remains constant, and that the processes that we have introduced affect only the remaining death rate—which, we assume, involves only the just-born. The population not only remains stable in size over time. Those who are alive are all adapted to the environment inhabited. Their TR lines

all vary in length and position relative to the Actual Range line; but in all cases those TR lines extend beyond the upper and lower limits of the AR, meaning that all are “fit” for the area. They may vary in their “fitness,” but that fact has no significance—for living in area A, at least.

Given that no mechanism is operative that would cause change over time in variables other than TR, one can assume that the population remains stable over time in all conceivable variables. That is, if for any given variable the mean were determined for successive years, those means were plotted as points on a graph, and a “line of best fit” was then drawn through the resulting “cloud” of points, that line would be a straight one, and would be perfectly parallel with the X axis.

Next, let us assume that we allow migration to occur from area A to each of the six subareas depicted on Figure 7; for the sake of simplicity, assume that this migration takes place instantaneously, with the number entering a given area being exactly proportional to the size of the area. Assume that each of these subareas differs in its environmental characteristics from the “mother” area as well as each other—but that the E scale indicated on Figure 7 still applies to all. In stating that each has a different environmental situation, but that the E scale is still applicable, I am in effect saying that each subarea now has an AR that differs from that for the “mother” area and all other subareas.

We now have a destabilized situation in area A, and situations in the six subareas that will need to move toward stabilization. Area A will now be at a population level somewhat below a carrying capacity level, so that there is “room” for more individuals of the species. The new situation in area A will not provide any help to those with “inadequate” TRs—those of the just-born with the ill fortune to be born with them will continue to die prematurely. However, the random group referred to above—who died through no fault of their own (all *did* have “adequate” TRs)—will not now need to die. In fact, it may take some time for area A to become “fully stocked”—necessitating random deaths once again.

What about the subareas? Each has an AR that differs from that of the “mother” area as well as each other subarea. This means that some individuals who would not have been able to survive in the “mother” area will now be able to survive. It will also mean that the populations that will develop in these subareas will begin to diverge from that of the “mother” area, and one another. The divergence, however, will only be of a quantitative nature, and will pertain only to environmental adaptation. If, though, there are other variables that happen to be highly correlated with environmental adaptation, there will also be divergence in those other variables as well. That is, it is possible that the mean—for a given year—for several variables will be different for each of our seven areas—“mother” area plus six subareas.

What about variation over *time*, however? Until a situation of carrying capacity occupation is re-achieved in area A, and achieved in each of the subareas, some variation in time might be observed in some variables. However, in each of the seven areas a situation of stability will be achieved at some point, and there will be a situation similar to that which existed in area A prior to the migration—the only difference being that each of the seven areas had a certain uniqueness. We can perhaps say, from a biological standpoint, that we have a Species in area A and six varieties of that Species in the subareas—one, and only one, variety in each subarea. (Each of

the seven areas contains other species and varieties, of course, but our interest here is not in that fact.)

What we have here is a situation of *stasis* in all seven areas—but that is not the ending that we want. We want, rather, a situation of *constant change*. How can we get it? One way to achieve constant change is to have the environment of each the seven areas become changeable—either in some sort of regular way, or in an irregular—and rather erratic—way. But that way was not Darwin’s way—although it is a way that would have a great deal of real-world realism, especially if viewed from the standpoint of geological time. Rather, Darwin derived his cue from breeding. He observed that a breeder, by controlling which individuals would be allowed to produce progeny, could create *directionality* with the species in question. That is, a breeder could have a certain trait—such as volume of milk production with cows—increase over time. The change would be slow, but it would be steady, and—most importantly—it would be “progressive” (from the perspective of what he was seeking).

Was there an analogous mechanism operating in nature? If so, what was it? It was here that Darwin perceived the possible relevance of Malthus’s “law” that population grows at a geometric rate whereas food grows only at an arithmetic rate. The significance that Darwin saw in this “law”—a “law” which he evidently did not question (or didn’t *want* to question!)—was (as I noted in the previous chapter) that it would result in intra-specific competition, and that the “best” would survive in that competition.⁸² With that occurring year after year, that trait would become more and more pronounced in the species—the species would be in a continual process of change, at least in terms of that “success” variable, and any other variables that happened to be correlated with it (p. 12).

The above, then, is virtually the whole of Darwin’s theoretical thinking, with the exception that I have made no reference to the role that extinction played in his thinking. Darwin said little about extinction in *Origin*, and what he *did* say was not at all clear, but let me quote two passages that relate to the subject. On p. 6 he stated that “Natural Selection almost inevitably causes much Extinction of the less improved forms of life, and leads to what I have called Divergence of Character.” On p. 91 he stated that he thought that “it inevitably follows, that as new species in the course of time are formed through natural selection, others will become rarer and rarer, and finally extinct. The forms which stand in closest competition with those undergoing modification and improvement, will naturally suffer most.” And: “each new variety or species, during the progress of its formation, will generally press hardest on its nearest kindred, and tend to exterminate them.” Finally, on p. 141 he said: “As natural selection acts solely by the preservation of profitable modifications, each new form will tend in a fully-stocked country to take the place of, and finally to exterminate, its own less improved parent or other less-favoured forms with which it comes into competition. Thus extinction and natural selection will . . . go hand in hand.”

⁸² Darwin used the word “best” on, e.g., p. 175, but in the context of breeding. I don’t recall him using that word in the context of natural selection, although it is clear that he believed that only those with the most of that trait that conferred success in intra-specific competition would “win” and therefore survive.

From these brief references to extinction we learn that Darwin believed that natural selection had not only the result of changing (“improving”) a given species, but extinguishing the “parent.” This raises two questions. First, in what respect(s) does natural selection result in improving a species? It’s true that, as natural selection is conceived, its operation results in intensification of the variable that confers survival to individuals of the species, but why think of that as being “improvement”? It’s possible that intensification of the “success” variable will—if that variable is correlated with certain other variables—result in “improvement” if those other changes can be thought of as constituting “improvement.” But Darwin did not state that—suggesting, rather, that a mere *intensification* of the success variable constitutes improvement. Because he advanced no reasons for accepting that assertion, we have no reason to accept it. This is a point that belongs, rather, in Chapter 11—and will be reiterated there—but this happens to be an opportune occasion to mention it.

Darwin’s explanation for extinctions appears to be that a given species competes with close kindred, resulting in their extermination—the close kindred involved being less developed, and by implication older. In fact, what Darwin seemed to be suggesting is that “child” would compete with “parent,” and because of child’s superiority, would in time exterminate the parent. In the context of the model that I have presented here, at least, this argument simply makes no sense. Within the model the population within a given area constitutes an *interactional group*, with the group having certain winners and losers. Assuming that the competition occurs on a seasonal (rather than continuous) basis—a point developed in Chapter 8—once the period of intra-specific competition is over for a season, the group resumes as an integrated group. This situation is true year after year, with the only change being an increase, year by year, of the mean of the success variable. The point that I am attempting to make here is that there is always an *integrated* group; there is no segregation into “parent” and “child” groups. Therefore, there is no basis for the parent-child competition to which Darwin refers.

Could this sort of situation exist in the real world, however? Possibly. But I will need to be presented with a plausible scenario that presents such, and Darwin has offered us none. His attitude seems to have been: I assert it, *therefore* it’s true. Which is not good enough!

Where has this journey taken us? The *macro* part has given us a sort of pseudo-speciation, in that it has given us varieties—their basis being adaptation to differing environments. Once that differentiation developed, however, it ceased developing further—until we introduced the *micro* element of natural selection into the scene. Then, we got *quantitative* change in the variable that provided a competitive advantage, and also got the same sort of change in any other variables that happened to be highly correlated with the “success” variable. However, natural selection gave us no *qualitative* change, because there was nothing in its mechanism that would produce such change. Finally, we had the macro element of *extinction*, but the explanation given for it had no rational basis—and likely has little in the way of empirical support anyway. Where, to repeat, has the journey taken us? Virtually nowhere! And as to natural selection, we will have much more to add to the pile in the next four chapters. It appears that a philosopher was not far off the mark in stating (alluding, though, specifically to Herbert Spencer’s writings) that “Evolution is a change from a nohowish untalkaboutable all-alikeness to a somehowish and in

general talkaboutable not-all-alikeness by continuous sticktogetherations and somethingelseifications.”⁸³

The remainder of Part Two, then, is devoted to the principal concept in *Origin*, that of natural selection. Chapter 8 expands on what has been said so far about natural selection by seeking to clarify the meaning of the term: It comments on *scope* ambiguities regarding natural selection in *Origin*; presents Darwin’s definition of the term, and offers some preliminary comments on it; and, finally, offers three “translations” of Darwin’s definition—one by a sociobiologist, one by a noted biologist and, finally, one by myself. Chapter 9 then expands the meaning of natural selection by identifying and discussing 12 selection models, one of them being the natural selection model (presented graphically in this case, given that an abundance of verbal presentation had already occurred. Chapter 10 then presents a defense of the “translation” that I had offered at the end of Chapter 8. And, finally, Chapter 11 offers a critique of the natural selection model.

⁸³ Quoted in Richard Hofstadter, *Social Darwinism in American Thought*. Boston: Beacon Press, 1955, p. 129. First published by the University of Pennsylvania Press in 1944.

Chapter 8: Clarifying the Meaning of Natural Selection

The aim of Chapter 8 is to add clarity to the meaning of “natural selection”—a term that Darwin used repeatedly in *Origin*, but never clarified to any significant degree. One might, I suppose, argue that Darwin wished the reader to infer the meaning he intended from his numerous usages of the term. The problem with that viewpoint, however, is that Darwin did not use the term in a consistent manner—if only from a scope standpoint (a matter pursued in the first section below). The second section focuses on an integral aspect of the natural selection model, that which it predicts. Once one knows what it predicts, one can seek mechanisms that yield that prediction, with the one-and-only “correct” one being among that group. The third section examines that prediction from a different perspective—extra-scientific factors that may have attracted Darwin to that prediction (or *explanandum*). Finally, in the fourth section Darwin’s definition of natural selection is presented, and some preliminary comments are offered on it. And the chapter concludes with three “translations” of Darwin’s definition, one by a sociobiologist (David P. Barash), one by a biologist (the late Ernst Mayr), and finally, one by me.

A. What is the *Scope* of Natural Selection?

One of the difficulties associated with arriving at a clear concept of “natural selection” is that the term is seemingly given different meanings at different points in *Origin*. In using the label “different” here, I do not mean to suggest that the meaning Darwin gave “natural selection” in one part of *Origin* was in *conflict* with the meaning given the term in another part of the book.⁸⁴ Rather, what I mean is that the *scope* of “natural selection” seemingly differs in different parts of *Origin*. Having pondered this possibility over a period of years, I conclude that Darwin gave “natural selection” *four* different meanings (from a scope standpoint) in *Origin*, and use the first section here to identify and comment upon those four different concepts of “natural selection.

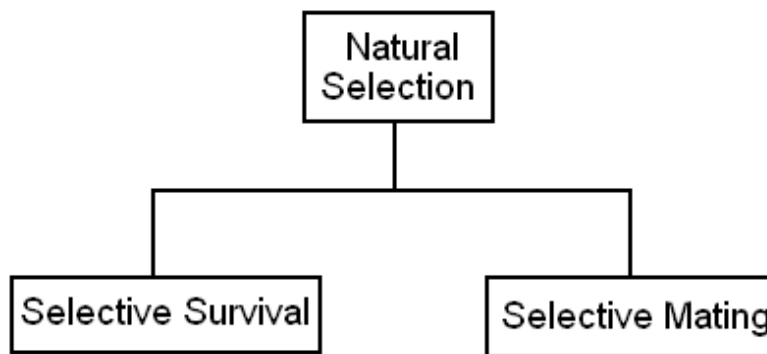


Figure 8: Natural Selection: Concept One

⁸⁴ This is not to say, however, that there are not conflicts between some of his usages that go beyond the matter of scope.

What Figure 8 illustrates is a concept of “natural selection” wherein the term is used as an umbrella concept that encompasses both selective survival and selective mating. Why think of Darwinian “natural selection” in terms of this concept—i.e., as an all-encompassing concept? Because Darwin, at one point (p. 53) in *Origin*, stated that “I use the term Struggle for Existence [which struggle was responsible for natural selection, per Darwin—as I have already noted] in a large and metaphorical sense, including dependence of one being on another, and including (which is more important) not only the life of the individual, but success in leaving progeny.” What this statement seems to suggest is that Darwin thought of “natural selection” as including not only the selection associated with selective *survival*—regardless of the mechanism involved—but also the selection associated with *sexual* selection.

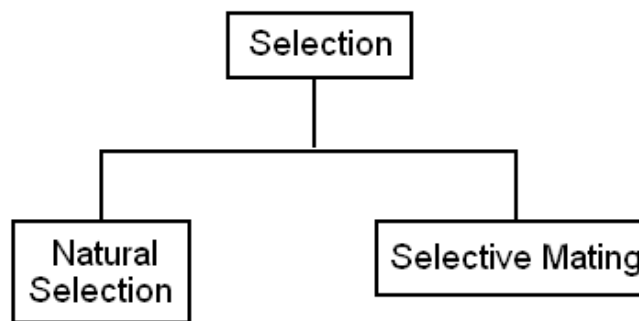


Figure 9: Natural Selection: Concept Two

Figure 9 illustrates a concept of “natural selection” such that two, and only two, types of selection are recognized in nature⁸⁵): Natural selection and selective mating (i.e., sexual selection). Why argue that this is how Darwin thought of natural selection? Because in *Origin* he clearly distinguished between “natural selection” and “sexual selection” (e.g., Chapter IV on Natural Selection has a section on pp. 73-75 entitled “Sexual Selection,” and Darwin made references to “sexual selection” at various points later in the book). Thus, given that Darwin referred (in *Origin*) to two types of selection—labeling one “natural selection” and the other “sexual selection” there is a definite basis for contending that Darwin thought of there being two, and only two, kinds of selection occurring in nature.

(As an aside I should note that at one point [p. 125] Darwin referred to “steady selection,” but did not define the term—except to state that it acts to “keep the breed true.” Perhaps Darwin meant by “steady selection” what David P. Barash⁸⁶ has termed “normalizing” or “stabilizing” selection. At any rate, it is not clear whether Darwin regarded “steady selection” as a type of

⁸⁵. This qualifier is added in recognition of the fact that *artificial selection* (i.e., breeding) is another type of selection, but not one that occurs in nature.

⁸⁶. David P. Barash, *Sociobiology and Behavior*. New York: Elsevier, 1977, p. 17.

natural selection, or as something different. Therefore, I make no further reference to Darwinian “steady selection.”)

The concept of “natural selection” illustrated in Figure 10 is one in which selective survival is distinguished from selective mating, but selective survival is not equated with natural selection. Although Darwin himself did not distinguish between selective survival resulting from environmental change and such survival resulting from natural selection, one can argue that such a distinction is implicit in *Origin*. The reason for so arguing is that implicit in Darwin’s discussion of natural selection is the assumption that the environment is not changing; in effect, that is, Darwin was holding that factor constant in discussing the mechanism associated with natural selection. In that Darwin believed that spatial variations in environmental conditions could help explain spatial variations in the characteristics of a species, one can make the reasonable inference that Darwin believed that environmental *change* could result in species change. I do not, however, recall any passage in *Origin* wherein Darwin explicitly discussed that possibility. But despite that fact, it is reasonable to argue that Darwin implicitly distinguished between species change attributable to natural selection and such change attributable to environmental change; so that he would not have referred to the latter as involving natural selection.

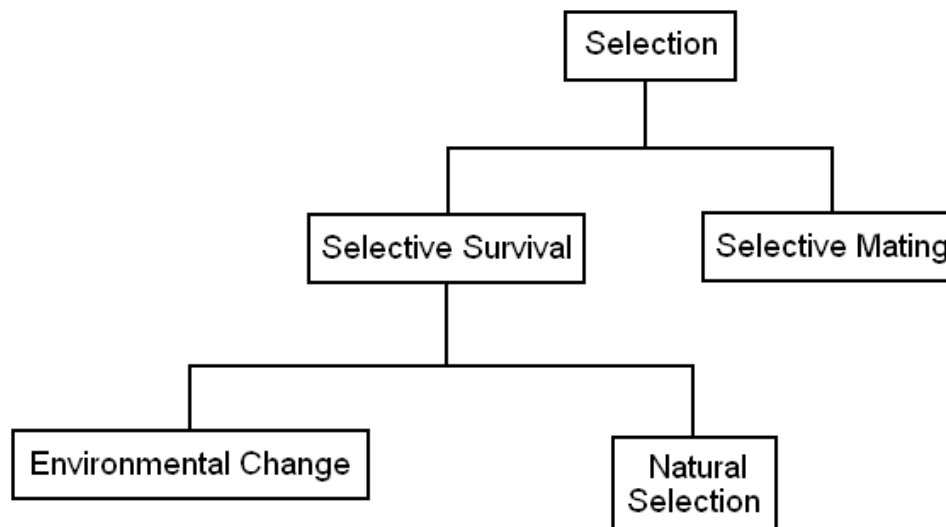


Figure 10: Natural Selection: Concept Three

Figure 11 offers yet another possibility. In this case “natural selection” has a rather narrow meaning. Selective survival is distinguished from selective mating (i.e., sexual selection), and selective survival is recognized as occurring either as a result of environmental change or “other” factors. These “other” factors include unusual weather conditions, predation, accidents, diseases—and natural selection. Thus, natural selection is thought of as but one among several selection mechanisms associated with selective survival.

Is this how Darwin thought of “natural selection” in *Origin*? The “definition” of “natural selection” offered by Darwin in *Origin* that is quoted in a later section makes no reference to selection via, e.g., predation, yet Darwin made reference to predation at various points in his

book. This fact suggests that Darwin thought of selection resulting from natural selection as involving a mechanism that *differed* from the selection mechanism associated with predation, with disease, etc. Even if Darwin did *not* do this, one can argue that the *effects* that Darwin associated with natural selection are not effects that can be associated with, e.g., predation (as we shall see in the next chapter)—so that for that reason we cannot think of, e.g., predation as a mechanism associated with natural selection.

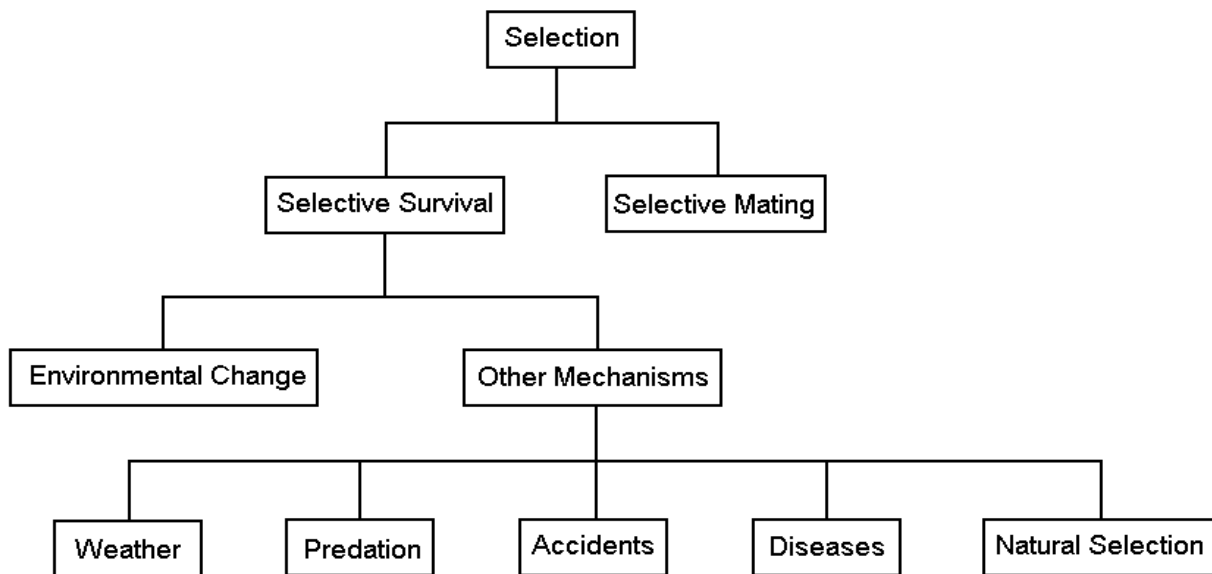


Figure 11: Natural Selection: Concept Four

In concluding this section, I should point out that all four of the possibilities discussed above relate *only* to monotypic evolution. What this means is that although there is good reason to think of Darwin’s theory of natural selection as a theory associated with *monotypic* evolution, there is *no* reason to associate it with *polytypic* evolution.

Which of these four concepts of natural selection shall we regard as the “true”—or at least the dominant—meaning of “natural selection” in *Origin*? In addressing this question it will be useful to begin by asking: Precisely what is it that natural selection *predicts*? An answer to that question will not allow us to identify the mechanism associated with natural selection, but *will* allow us to *exclude* certain mechanisms. For that reason, this is a very useful point to begin as we begin the process of clarifying the meaning of “natural selection.”

B. What Natural Selection Predicts

If, in undertaking the task of clarifying “natural selection”—i.e., in this case deciding the dominant scope of the concept in *Origin*—we begin with the name, and postulate that Darwin intended a meaning for “natural selection” that had similarities with “artificial selection” (i.e., breeding), we can first ask: Is it likely that Darwin thought that a mechanism was operating in

nature that was similar to breeding? My answer to this question is “no,” for I see no basis for answering that question in the affirmative. If natural selection and artificial selection do not have similar mechanisms, how else, then, can they be similar? The one and only answer to *that* question is that Darwin must have postulated that the two different mechanisms had similar *consequences*. Given this conclusion, the implication is that if we determine the consequences of artificial selection, we will have identified the consequences that Darwin associated with natural selection (so far as the *dominant* meaning he gave the term, at any rate). (The fact that Darwin’s first chapter (“Variation Under Domestication”) is devoted to the topic of breeding offers additional proof that Darwin saw natural selection as something relatable to “artificial selection.”)

Let us, then, briefly discuss what is involved with “artificial selection” (i.e., breeding⁸⁷), noting here what such selection entails:⁸⁸

- Human individuals do the selecting.
- Their selecting is directed toward a group of individuals of a given (non-human) species. Members of that group comprise but a small number of the total number of individuals of the species in question. However, the group is large enough that it can be maintained as a closed breeding group, and is in fact so maintained.
- Members of the initial group include both males and females (but especially the former, perhaps).
- Individuals are chosen for inclusion in the group on the basis of their possession of a trait(s)—apparently having a genetic basis—desired by the human selectors: They have the trait(s) to a greater degree than other individuals, but not to a sufficient degree. (If individuals already had the desired trait(s) to the desired degree, there would be no necessity in undertaking the breeding activity!)
- The selecting undertaken by the individual(s) engaging in the selection process is goal-oriented. This goal may be:

⁸⁷. Here is a brief statement regarding the purpose of animal breeding: “In animal breeding, we aim to make genetic changes in particular livestock populations to improve their productivity in a particular production system.” The statement is by Prof. J. S. F. Barker of the Department of Animal Science, University of New England NSW (in Australia), and appeared in his “Genetic Diversity and Animal Breeding,” a speech given by the 1998 Helen Newton Turner medal recipient. The address appears on the internet at <http://agbu.une.edu.au/~aaabg/hnt.html>. The “agbu” here stands for Australian Association of Animal Breeding and Genetics.

⁸⁸. Breeding (i.e., “artificial selection”) is a complex topic, and I do not pretend to be any sort of expert on the subject. Of the numerous books / articles on the subject, I will mention here just one, Richard M. Bourdon's *Understanding Animal Breeding*, second edition published in 1999.

- An absolute one (such as a certain *appearance*), so that once the goal is achieved, what is wanted is to *maintain stability* in the characteristic(s) sought. What is wanted, in other words, is that members of the group will “breed true.”
- Continually more (or less) of a given attribute (such as speed), so that the goal may be pursued indefinitely (or until a certain biological limit is reached).

(Why the individual(s) involved in the breeding selected that particular goal is not a matter addressed here.)

- Selection *per se* involves two types of selecting, selection for *survival* and/or selection for *mating*. Assuming that the individuals involved are of a given *animal* species, these two types of selection would be employed thusly:
 - If, upon the birth of offspring, the selector can determine which individuals most have the desired trait(s), those individuals are kept and allowed to live (and later mate), and the other individuals are disposed of (killed, sold, given away, etc.). That is, (what might be called) *selection for survival* occurs; given that all those selected for survival are allowed to mate, no selection for mating occurs.
 - If, of offspring born, one *cannot* immediately determine which most have the desired trait(s), all offspring are allowed to live until an age when such determination *can* be made. Individuals most having the desired trait(s) are then allowed to continue living (and allowed to mate, when ready for such), and the other individuals are disposed of in some fashion (killed and eaten; allowed to live, and used for some other purpose, or sold; etc.). Thus, *selection for survival* occurs, followed (perhaps rather closely) by *selection for mating*.

It should be noted here, first, that the “trait” being referred to here can be thought of either as one measured on a *nominal* scale (either an individual has, or does not have, the trait), or on a *continuous* one (e.g., speed). In the first case the selector selects for his/her breeding program just those individuals having (or *most* having) the trait. And the implication of the breeding activity is that the percent of individuals within the group having (or most having) the trait will increase over time, until it reaches (ideally) 100%. The increase, from year to year, might be linear, but need not be. (If it is not linear, it is likely to be curvilinear, with the rate, expressed in terms of percent points, decreasing with time.) In the second case, the selector selects just those individuals exhibiting the trait above (or below) a certain degree (or amount)⁸⁹, the cutoff point being selected at the discretion of the selector. The implication of that activity is that the average (e.g., mean) value for the variable in question will increase (or decrease) from year to year; again, the increase (decrease) may be linear, but need not be. (Again, if it is not, it is likely to be curvilinear, with the rate decreasing over time.)

⁸⁹. “Degree” is appropriate if one is referring to measurement involving a continuous scale (e.g., interval or ratio scale); “amount” if one is referring, not to measurement, but to the use of counting numbers (and the so-called “absolute” scale).

The second fact to be noted regarding artificial selection is that it involves *both* selection for survival *and* selection for mating. On the one hand, some individuals are selected for retention in the group, and others are removed from the group (with “removal” taking different possible forms). And of those individuals selected for retention, not all will necessarily be selected for mating—although usually it makes sense to retain only those individuals who will be allowed to mate (which commonly will involve retaining but one male to “service” the various females retained). What’s important to keep in mind here is that selection for survival and selection for mating should not be thought of in either/or terms—that either one occurs, or the other. Artificial selection (i.e., breeding) commonly involves *both* selection for survival *and* selection for mating, although commonly only those are selected for survival who will be allowed to (later) mate.

Evidently Darwin saw (or thought he did) the sort of change in nature that could be obtained with breeding (i.e., “progressive” change in terms of certain traits), and concluded that there *must* be a process in nature that is analogous to what occurs with breeding—at least in the sense of producing the same sort of result. (Shortly, I provide evidence supporting that conclusion.) Given that the term *artificial* selection was used to refer to breeding, it seemed entirely appropriate to use the term *natural* selection for what occurred (he claimed) in nature. That is, in nature “progressive” change could—and did—occur (Darwin asserted), *as if a selecting* was occurring in nature that was producing this change.

What we have learned thus far, then, is that Darwin thought of natural selection as a process with affinities to “artificial selection,” especially in that both processes yielded the same *results*. That is, just as artificial selection resulted in change over time within a given group, so does change occur in nature—but as the result of some *other* process. Darwin’s “task,” then, was to discover that other process; and he used the term “natural selection” to refer to that process. Put another way, although a theory is properly thought of as consisting of both an *explanandum* and an *explanans*, Darwin, in using the term “natural selection,” used it to refer to just the *explanans* portion of his “theory.” (As I noted in the Foreword, an oddity of his presentation is that discussions of natural selection *per se* never refer to that which the mechanism associated with natural selection is supposed to *explain/produce!*)

Breeding involves change in a species that is (a) steady and (b) progressive. This means that insofar as Darwin saw *natural* selection as a sort of selection that paralleled *artificial* selection, he thought of natural selection as *also* steady and progressive. But did Darwin actually state this anywhere in *Origin*? The answer is, “Yes, he did.” First, given his numerous references to “accumulation” (e.g., on p. 39), it is clear that Darwin thought of natural selection as producing *steady* change. And second, various statements in *Origin* make it clear that Darwin thought of the change associated with natural selection as *progressive*. For example, on p. 68 he referred to natural selection as having a “free scope for the work of improvement.” On p. 105 he asserted that natural selection “leads to the improvement of each creature in relation to its organic and inorganic conditions of life.” And in *Origin*[6], p. 160, he declared: “Although we have no good evidence of the existence of an innate tendency towards progressive development, . . . this necessarily follows . . . through the continued action of natural selection.” (This last quotation is from Chapter VII, “Miscellaneous Objections to the Theory of Natural Selection”—which chapter did not appear in the first edition of the book.)

Not only did Darwin clearly think of natural selection as involving steady, progressive change. He stated several times that the change involved was *slow*. In, e.g., stating (p. 89) that “natural selection will always act with extreme slowness . . .,” and asserting (p. 158) that “she [i.e., natural selection⁹⁰] can never take a leap, but must advance by the shortest and slowest steps,” Darwin made clear that he thought of natural selection as producing *slow* change.

In summary, then, the fact that Darwin’s first chapter discusses breeding leads us to believe that Darwin thought of natural selection as “producing” steady, “progressive” change. And various comments made by Darwin in other parts of *Origin* support that conclusion—and add that natural selection is a process that occurs very slowly. Thus, there is good reason for concluding that Darwin thought of natural selection as involving—by definition—(a) slow, (b) steady, and (c) progressive change in a given species. Which implies, of course, that Darwin thought of natural selection as a “theory” that explained *monotypic* evolution (a type of evolution that involves only *quantitative* change), but not *polytypic* evolution (a type of evolution that involves qualitative, and perhaps *also* quantitative, change).

Having concluded what sort of change natural selection produces, the next topic to address is: What is the *mechanism* that Darwin associated with natural selection? We now know that that mechanism must produce slow, steady, progressive change, but that fact does not in itself “tell” us what natural selection *involves*—for there are several *different* mechanisms that can produce such change. The following chapter will explore that matter; before closing this section, however, I would like to offer some speculations regarding *why* Darwin insisted that there was a process in nature that produced slow, steady, progressive change: Did Darwin have *evidence* that this was how change occurred in nature? Was he merely *projecting* onto nature the sort of change that was associated with artificial selection? Or were there other—extra-scientific—factors that affected Darwin’s decision to think of natural selection this way (i.e., as producing slow, steady, progressive change)?

C. Why Did Darwin Think This Way?

Why did Darwin insist that species (plural) changed slowly, but inexorably, and in a progressive fashion? This question is worth dwelling on briefly. First, though, it should be pointed out that Darwin’s view here was in opposition to the Great Chain of Being concept which had dominated Western intellectual life since the Renaissance (although the concept originated much earlier, with Neoplatonists such as Plotinus [205-270 CE]). The Great Chain of Being concept consisted of a series of assumptions:

- Beings can be thought of horizontally in terms of varying degrees of similarity.
- They can be thought of vertically in terms of levels of complexity—from simple life-forms on up to God.
- There is “plentitude.” That is, everything *possible* (referring to beings) is *actual*; the

⁹⁰ Note Darwin’s feminization of natural selection here.

universe is full, containing all the kinds of beings it *can* contain. In addition, the concept of plenitude included the assertion that all beings had been *created* at some past point in time, and were *immutable*—implying that extinctions *had* not occurred, because they *could* not occur!

Loren Eiseley⁹¹ has made the astute comment that evolutionary thinking—which by its very nature challenged the Great Chain concept—likely began in France because the social system there was “dissolving” (thus changing), and thereby fostering the development of a new perspective on human society—and life-forms in general. I would add only that I agree with R. G. Collingwood that the development of *historical* writing in France (by such luminaries as [Voltaire](#)) also had a profound influence on how French intellectuals were beginning to perceive nature.⁹² Thus, Darwin may have thought of temporal change as he did in part because historical thinking was “in the air” at the time (not just because empirical facts seemed, in his mind, to support this view).

Second, I should note that prior to Darwin, insofar as naturalists offered explanations for evolution, they commonly did so using the theory that *acquired* characteristics can be transmitted to progeny—a theory often referred to as “Lamarckism” (or “Lamarckianism”) after Jean Baptiste Pierre Antoine de Monet, Chevalier de Lamarck. A theory which, by the way, *also*, however, predicted that change would be slow, steady, and progressive! When *Origin* was first published (in 1859), Darwin basically rejected this theory. But as he grew older, he found the explanation more and more acceptable.⁹³ (After all, Grandfather Erasmus Darwin had been an early proponent of the theory that acquired characteristics can be transmitted to progeny.⁹⁴) Thus, Darwin may have “picked up” his view of how species change from prior Lamarckians (including his own grandfather), differing from the Lamarckians, though, in his *explanation* of change.

Third, Darwin accepted the geological doctrine of uniformitarianism, and this may have affected how he thought about life-forms (not just *landforms*). His acceptance of this belief undoubtedly reflected his association (as a rather close friend) with noted geologist [Charles Lyell](#) [1797-1875]—with whom the doctrine of [uniformitarianism](#) was very much associated. (This concept, developed by [James Hutton](#) [1726-1797] during the eighteenth century, was used to understand geologic history: The same forces that are acting now to shape the earth have always acted, and they tend to act slowly.) Presumably, Darwin not only acquired the habit of thinking in temporal (specifically, *developmental*) terms from his friend Lyell, but also acquired the habit of thinking in terms of slow, steady (but not necessarily “progressive”) change. Thus, he may have insisted

⁹¹. Loren Eiseley, *Darwin's Century: Evolution and the Men Who Discovered It*. Garden City, NY: Doubleday & Company, Inc., 1958, p. 10.

⁹². Floyd W. Matson, *The Idea of Man*. New York: Dell Publishing Company, Inc., 1976, pp. 32-35.

⁹³. Ronald W. Clark, *The Survival of Charles Darwin: A Biography of a Man and an Idea*. New York: Random House, 1984, p. 152.

⁹⁴. Eiseley, *Darwin's Century*, p. 48.

on slow, steady, progressive change in the biological realm not so much because he was aware of empirical observations that supported such a position but, rather, because he accepted the doctrine of uniformitarianism.

There is another way of looking at Darwin's position on change, however. "Jumps implied God, and he [Darwin] wanted to give no open door by which miracle-mongers could enter and say it was all by acts of special creation."⁹⁵ Ernst Mayr has added that the death of Darwin's daughter Annie (in 1851) "seems to have extinguished the last traces of theism in Darwin."⁹⁶ Thus, although the influence of contemporary geological thinking on Darwin's views regarding species change is undeniable, it is possible that Darwin's theological views were also involved—so that he believed in slow, steady, progressive change for other than solidly rational reasons.⁹⁷

But regardless of *why* Darwin thought of natural selection as producing/predicting slow, steady, progressive change, the fact is that he *did*—and this fact can help us determine which of the mechanisms that can produce slow, steady, progressive change is the one that is properly associated with Darwinian natural selection—whether or not Darwin himself did. The next chapter, then, explores that matter, and offers conclusions in support of the "translation" that I offer at the end of this chapter. However, so important do I regard that matter that I devote Chapter 10 (a defense of my "translation") to it as well.

D. "Darwin's Definition, and Preliminary Comments on its "Translation"

What *is* "natural selection" anyway? In addressing this question, let us first use a "word analysis." In using this approach we can first observe that the term suggests that some sort of *process* is being referred to. A process, indeed, that is similar to, yet distinguishable from, the process(es) associated with its apparent opposite—"artificial selection," or breeding. The term "selection" here, second, suggests that a *selector* does the selecting that is associated with the process involved here (whatever it is); and given the presence of a *selector*, the implication is that the selecting is being done by a living creature—specifically one that is *capable* of making *decisions*.

Another implication associated with "natural selection" is that the selecting that is occurring is not done randomly but, rather, that it involves *selectivity*. In other words, the selector is selecting the "things" toward which his/her selecting is directed on the basis of certain definite *criteria*: Those individual "things" that meet these criteria are selected, with the remaining individuals being, in effect, rejected. *Why* the selector is selecting certain individual things in favor of

⁹⁵. Vernon Blackmore and Andrew Page, *Evolution: The Great Debate*. Oxford, UK: Lion Publishing, 1989, p. 122.

⁹⁶. Ernst Mayr, *One Long Argument*. Cambridge, MA: Harvard University Press, 1991, p. 15.

⁹⁷. I might add that Darwin's fixation on *struggle* associated with natural selection may also have had an extra-scientific origin. Adrian Desmond and James Moore have noted that while the Crimean War was going on (the allies had entered it in 1854), "Darwin was thinking about the parallel warfare of nature . . ." Adrian Desmond and James Moore, *Darwin*. New York: Warner Books, 1991, p. 419.

certain other individual things of the same type is something that an outside observer might, or might not, be able to infer (or otherwise determine). *That*, however, is a matter that we need not concern ourselves with here.

An important point to note about the *term* “natural selection” is that it does *not* carry with it the implication that “natural selection” is anything other than a *one-time, non-repeated* process. In fact, however, Darwin, in using the term “natural selection,” clearly thought of the process involved with it in *temporal* terms—i.e., as one that occurs *continually* (if not continuously), up to a point, at any rate. And although subsequent writers who have referred to “natural selection” have not necessarily defined it similarly, they have been unanimous in thinking of it as a process that “operates”—at least continually—*over time*.

Given that our “word analysis has not carried us very far—and perhaps has obfuscated matters more than clarified them!—let us next go directly to Charles Darwin’s *Origin* to see what Darwin wrote about “natural selection” (in an attempt to clarify its meaning for readers). Then, because Darwin’s “definition” is less than satisfactory (to put it mildly!), I present the “translations” of sociobiologist David P. Barash and Ernst Mayr, followed by one of my own. In Chapter 10 I then defend my “translation” (after, in chapter 9, presenting and discussing a number of selection scenarios). In *my* translation I at times refer to natural selection as a *process*, at times as a *mechanism*, at times as a *concept*, at times as a *model*, and at still other times as a *theory*. In doing so I emulate Darwin, who applied different labels to “natural selection” at different points in his discussion; for example, within the space of three pages (pp. 165 - 67) he referred to it as, successively, a “principle,” “theory” (my theory,” in fact), “process,” and “power.” Use of different labels for “natural selection” ostensibly indicates inconsistency; actually, however, it indicates recognition that different labels are appropriate in different contexts (or at least *may* so indicate!).

Darwin’s initial definition (or at least discussion) of natural selection occurs on p. 6 of his “Introduction” (and is herein treated as the benchmark Darwinian definition of “natural selection”:

In the next chapter [I: Variation Under Domestication] the Struggle for Existence amongst all organic beings throughout the world, which inevitably follows from the high geometrical ratio of their increase, will be treated of. This is the doctrine of [Thomas] Malthus, applied to the whole animal and vegetable kingdoms. As many more individuals of each species are born than can possibly survive; and as, consequently, there is a frequently recurring struggle for existence, it follows that any being, if it vary however slightly in any manner profitable to itself, under the complex and sometimes varying conditions of life, will have a better chance of surviving, and thus be *naturally selected*. From the strong principle of inheritance, any selected variety will tend to propagate its new and modified form.

Darwin amplified this definition at later points in *Origin*—but added little of significance. Which means that “natural selection” is *never* defined very clearly or fully in *Origin*. Because of that

fact, it is advisable at this point to “translate”⁹⁸ Darwin’s definition, and I do so (as concisely as I can) as follows:⁹⁹

Natural selection is an “event” occurring within a given species (occupying a given area), such that during the event (one of intra-specific competition), numerous premature deaths occur—i. e., ones not attributable to “old age”—with those surviving being those, and only those, individuals at the upper end of the frequency distribution [examples of which are presented in the next chapter] for some given *observable* trait(s)—a trait(s) that confers upon survivors an ability to win in their competition with conspecifics. Given that the trait is an *inherited* one, the successive repetition of this event over time results in the species changing over time in terms of that trait (and other traits that happen to be correlated with it) in a steady, slow, progressive manner.

Although “natural selection” *per se* refers to a *single* selection event, the interest is not in a single such event but, rather, in a *series of successive* such events—the interest being specifically in the (purported) fact that these events result in *genetic*¹⁰⁰ change in the given species over time. This fact is usually tacitly understood in discussions of natural selection.

Before proceeding further I should note that the “struggle for existence” phrase used by Darwin is subject to more interpretations than the one I have given it—i.e., intra-specific competition. For example, it can also be interpreted as referring to (a) a struggle against the environment (such as was referred to by Prince [Peter Kropotkin](#) in his famous *Mutual Aid* (1902)¹⁰¹) or (b) a struggle against predators (such as discussed by Donna Hart and Robert W. Sussman¹⁰²). My reason for opting for my particular interpretation is that the mechanism associated with it will produce slow, steady, progressive change, whereas the mechanisms associated with the other possibilities will not. We have already seen this—relative to struggle against the environment—in the previous chapter, where the environmental adaptation discussed (which can be interpreted as involving struggle against the *environment*) produced stasis, rather than any sort of change—progressive or otherwise.

⁹⁸. Note that to “translate” Darwinian natural selection is not the same as to “flesh out” Darwin’s definition of it. The former involves mere *clarification* of the concept as presented by Darwin, whereas the latter (accomplished in Chapter 5) involves identifying assumptions *missing* from Darwin’s discussion—i.e., identifying “missing links” (!) that need to be added to the Darwinian Amodel—to make it complete (so far as the relevant explanatory factors are concerned).

⁹⁹. At a later point (in this chapter), I present, and comment upon, two other “translations” that have been offered of Darwinian natural selection, and follow that discussion with a presentation of my own “translation.”

¹⁰⁰. To use a post-Darwinian term.

¹⁰¹ Available on the internet at, e.g., http://dwardmac.pitzer.edu:16080/Anarchist_Archives/kropotkin/mutaidcontents.html

¹⁰² *Man the Hunted: Primates, Predators, and Human Evolution*. New York: Westview Press, 2005.

To return to my brief “translation” above: It is an accurate, but highly condensed, one; thus, is not self-explanatory. Therefore, below I identify a series of questions related to the translation, and provide a brief answer to each—a *Darwinian* answer in each case (i.e., an answer consistent with the content of *Origin*). I should note that in providing specific answers here, I find it convenient to assume some given, but unidentified, *animal* species.

Two principles can be enunciated as guiding ones in the effort to clarify the meaning of “natural selection” in Darwin’s *Origin*:

1. *For a process to warrant the label “natural selection,” it needs to produce slow, steady, progressive genetic change in a species: this (i.e., slow, etc. change) is the only type of change that is properly associated with “natural selection.”* Darwin reiterated this point many times in *Origin*.
2. *Given, though, that (as we will see in the next chapter) at least two other distinctly different mechanisms¹⁰³ also can produce slow, steady, progressive biological change, a process is properly labeled “natural selection” only if, in addition, it is relatable directly to the above translation—and, of course, indirectly to the Darwin statement quoted earlier.* A common mistake is to apply the label “natural selection” to a process just because it produces slow, steady, progressive change (or some approximation of same) in a given species—or to use the term with the intent of adding sophistication (for the benefit of the unknowing) to one’s article/book/speech, etc.

In other words, in clarifying the meaning of “natural selection,” one *must* regard that which natural selection “produces” as an integral part of the concept; on the other hand, however, one must, of course, define “natural selection” in a manner that is consistent with Darwin’s dominant

¹⁰³. Especially when conceiving of natural selection as a *mechanism* should it become evident that the mechanism in question is “operating” in a *setting*; and that *how* the mechanism operates is in part dependent on the nature of that setting. The lesson here is that in creating a theory of natural selection (or whatever), one must not only include statements that pertain to the mechanism involved, but ones that pertain to the setting. These latter statements must be such that they “control for” the setting—they “neutralize” it by treating it as a constant. In addition, the theory should recognize the existence of other relevant mechanisms by explicitly including neutralizing statements regarding them.

Darwin, in discussing natural selection, made statements pertaining to the mechanism associated with natural selection, but failed to make statements pertaining to the setting and other mechanisms of relevance. Given the outcome that he associated with natural selection (i.e., slow, steady, progressive change), however, it is clear that certain *tacit* assumptions were being made regarding the setting of his mechanism and regarding alternate mechanisms. That is, it is clear that he was (unaware, evidently) holding constant certain factors in his “thought experiment”: Environmental variability, sexual selection, etc. In my critique chapter (11) I identify the missing components of Darwin’s model.

The fact that *Origin* is a confused (and not merely *confusing*) book has resulted in different readers arriving at different conclusions as to what Darwin’s “message” was. *Why* is it a confused book? Surely part of the answer is that Darwin lacked a talent for modeling—and was unaware of the pioneering modeling efforts published in the early 1800s by Johann Heinrich von Thünen (whose name was encountered in the Introduction).

usage of the term. (To repeat: I use the word “dominant” here deliberately, because “natural selection” has a shifting meaning in *Origin*.)

I do not, in this chapter, *specify* how slow, steady, progressive change would look on a graph, except to say that a graphic equivalent of the words “slow, steady, and progressive” would be an upward-sloping line. (See the next chapter, rather, for a display of graphs.) The line might be a straight one (indicating that the rate of change was a constant), but might, instead, be a curved one. If the latter, it is likely to become progressively less steep (indicating a decreasing rate over time).

The reason for *not* being more specific about this matter is that the shape of the line would depend (all other relevant factors controlled for¹⁰⁴) on one’s assumptions regarding heredity, and it is not necessary for the purposes of my discussion here to be specific about the contents of that “black box.” Indeed, attention to that subject likely would divert attention from the matters that I wish to emphasize, without adding anything of significance to the discussion. This is *not* to say (obviously!) that principles of biological inheritance are of tangential interest to evolutionary biologists; it *is* to say, however, that given the approach I use in analyzing natural selection here, attention to such principles is unnecessary—and would be imprudent, because tending to divert attention from the points that I *do* wish to emphasize. (Which does not mean, however, that I give no attention to the subject of heredity in this book—for I *have* already, e.g., in the Foreword.)

Why is attention to the topic of biological inheritance unnecessary here? Whether one is referring to *Darwin’s* beliefs concerning heredity *or* to *currently-accepted* ones, *either* set of assumptions will produce slow, steady, progressive change in a given species—and it is *that* fact which plays an especially important role in my analysis. I *do* make some reference to Darwin’s beliefs concerning heredity, but make no effort to discuss those views in an exhaustive manner, nor to critique those views. Basically, however, although I am interested in the various assumptions that Darwin made in *Origin* (relative to natural selection), my interest in his assumption of slow, steady, progressive biological change is confined simply to the fact *that* he assumed this, rather than assumptions regarding principles of inheritance that he made to help him *explain* such change.

Now to the questions that need to be raised—and answered—in clarifying the (brief) “translation” of Darwin that I offered above (using a question-and-answer approach):

1. What is the *nature* of the “event”?

Intra-specific competition (rather than the other two possibilities that I just identified).

¹⁰⁴. More formally, *ceteris paribus*.

2. *Why* does that event occur?

Excess births; i.e., more individuals are born than can survive, given the area's carrying capacity.¹⁰⁵ Given that some members of the species must die, intra-specific competition occurs—and is the one and only factor (other than “old age” involved in determining which individuals will live, which will die.

3. What individuals in the group are involved in the intraspecific competition?

The just-born, and only them. (The very old may also be involved, but that fact would have no relevance because such individuals would already have produced progeny—if they had. Also, a minor other element would be the injured, deformed, ill, etc.)

4. What *causes* the premature deaths on the part of the just-born?

The first point to recognize here is that because natural selection (repeated over and over again) *must*, given how Darwin conceived it, produce slow, steady, progressive biological change, it is necessary to assume that the just born are “on their own” from birth (a point defended in Chapter 10). If parenting is allowed into the model, there will be no assurance of obtaining the required outcome; therefore, parenting behavior *must* be disallowed from the model.

It follows, now, that those individuals possessing the trait(s) that confers survivability will win in their competition with conspecifics—i.e., they will survive (with “losers” dying¹⁰⁶). In other words, those having this given trait(s) to the greatest degree will survive—and *only* such individuals (the limiting factor being the carrying capacity of the given area).

I need to add at this point that because the Darwin statement on p. 6 of *Origin* forms the benchmark for clarifying what natural selection entails (so far as Darwin was concerned), Darwin's statements in *Origin* regarding *other* causes of death must be ignored as irrelevant. This is not to say that real-world individuals do not die from causes *other* than intra-specific competition—for they do, and Darwin was, of course, well aware of that fact. It *is* to say, however, that the *dominant* meaning Darwin gave “natural selection” in *Origin* was such that premature deaths can be attributed to, and *only* to, intra-specific competition. Given that the meaning of “Darwinian natural selection” must be equated with the *dominant* meaning Darwin gave the term in *Origin*, and *only* with that meaning, Darwin's references to causes of death other than intra-specific competition must

¹⁰⁵. “Carrying capacity” is a seemingly innocuous term, but it is one that masks some serious problems with Darwin's theory of natural selection. The problems associated with this “can of worms” are identified and discussed in the next chapter.

¹⁰⁶. Because of being killed by conspecifics during the course of competition, or being unable to obtain food (e.g., because none is left for them).

be regarded as tangential “filler” that only serve to “muddy the water” so far as the definition of “natural selection” is concerned.

5. What sorts of traits¹⁰⁷ can confer survivability on an individual?

The following are examples (but not necessarily ones mentioned by Darwin in *Origin*¹⁰⁸):

- a. Size
- b. Speed
- c. Strength
- d. Absence of abnormalities (e.g., not missing limbs)
- e. Robustness of “constitution”
- f. Freedom from disease
- g. Aggressiveness

Note that of the seven traits listed, all are *physical* ones, but the final one is a *behavioral* one.

6. How *frequently* does the event (i.e., intra-specific competition) occur?

Darwin was silent on this point, but I will say for Darwin that the event is *seasonal* rather than continuous (or continual)—and, indeed, will occur but once a year.¹⁰⁹

7. Is the theory involved here one of monotypic evolution, polytypic evolution, or both?

Monotypic evolution only (if any of the three¹¹⁰).

¹⁰⁷. The factor of intelligence (a *mental* trait) could perhaps be added to the list, but this would come into play only with “higher” species. Given, however, that intelligence seems to be positively correlated with parental care, and that parental care has been disallowed from the model, intelligence cannot be added to the list.

¹⁰⁸. At one point (p. 66) Darwin declared that “the vigorous, the healthy, and the happy [yes! he wrote that!] survive and multiply.”

¹⁰⁹. In real-world terms “mating seasons” are common, but these tend to vary in frequency from species to species. Here, it is useful to assume a single annual mating season for our given species.

¹¹⁰. That is, one must keep in mind that just because the *term* Amonotypic evolution@ exists, it does not follow that monotypic *evolution* occurs (as opposed to mere monotypic change): one cannot *define* something into existence—and attempts to do so must be labeled as intellectual chicanery. Likewise, just because the term Aunicorn@ exists in our language, it does not follow that Aunicorn@ has (or has ever had) a real-world referent.

8. Does the theory “predict” species change? If so, what sort of change?

The theory *does* predict biological change in the given species, but whether that change warrants the label “monotypic *evolution*” is another matter. It would *seem* that whatever the trait(s) that confers competitive advantage (and thus survival, as it becomes magnified¹¹¹ in the group), that magnification does not *in itself* mean that the species is becoming a new species—i.e., that monotypic evolution is occurring—despite the length of time involved. It would seem, i.e., that (“mere”) *quantitative* change in the species *cannot* result in monotypic evolution (i.e., the emergence of a new species).

Ostensibly (i.e., writing as a non-specialist regarding genetics matters), *qualitative* change would be necessary before one could say that monotypic evolution had occurred; and *whether* such change would—or could—occur would depend (in large part, but not solely) upon what one puts in the “black box” containing assumptions concerning heredity. Given that I am not touching that box herein (!), I can make no conclusion as to whether the slow, steady, progressive change associated with natural selection would result in the emergence of a new species (were current beliefs regarding heredity “plugged into” the model). I *will* say, however, that whatever qualitative change is allowed into the model, it must be such as to confer competitive advantage on those individuals with the new trait(s); lacking this, it is of no interest for the “theory” of natural selection.

9. Does Darwinian natural selection *just* produce slow, steady, progressive biological change in a given species?

No. A necessary concomitant (“prediction,” if you will) of Darwinian natural selection is occupance of a given area, by a given species at, or near, a carrying capacity level—and virtually constantly.

In addition, one can argue that whatever *physical* trait(s) confers survivability, there will also be a tendency for the survivors to be the more *aggressive* of the individuals involved in the intraspecific competition that occurs. So that a *behavioral* trait—aggressiveness—seemingly is *also* predicted to increase via the process of Darwinian natural selection.¹¹²

Having presented a rather brief “translation” of Darwin’s definition-discussion of “natural selection,” I next present two published “translations” of Darwin’s theory of natural selection—one by a sociobiologist, the other by a noted biologist (now deceased), I comment on both, and

¹¹¹. That is, a collective value (e.g., the mean) increases over time.

¹¹² A caution that should be mentioned here is that the aggressive behavior that occurs can be thought of as occurring, not because of a hereditary proclivity for such behavior but, rather, as a result of the *competitive situation*—i.e., the *context* within which individuals find themselves.

then end this chapter with my own “translation”—which I then defend in Chapter 10. That discussion will repeat some of the points that I have already presented, but I want to make the reader “crystal clear” regarding the rationale behind my “translation” of Darwin’s concept of natural selection.

E. “Translations” of Barash, Mayr, and Thompson

1. Barash's Interpretation

Sociobiologist David P. Barash has summarized Darwin's theory of monotypic evolution thusly:¹¹³

1. If all parents of a species were to produce two (and only two) offspring, the population would remain stable. Typically, however, with any given species there is overproduction—i.e., a given adult produces more than just a “replacement.”

2. Despite this tendency for “overproduction,” however, populations tend to remain “remarkably stable” over time.

3. Individuals differ genetically, and these differences are transmitted to offspring.

4. Given that there is population stability combined with a tendency for “geometric” growth, it is evident that “some individuals are more successful than others in producing offspring and/or some offspring are more successful than others in becoming adults. In other words, competition occurs. Survival of the fittest simply means that those individuals possessing characteristics that render them more capable of surviving and reproducing will do so and . . . will be better represented in the next generation than will those individuals who are less fit.” What “natural selection is, then, is “the differential reproduction of individuals within a species, from one generation to the next.”

5. Which means that there is slow, steady change in the species—i.e., (monotypic) evolution, per Barash.

This purported summary of Darwin's views is a confused one, for it mixes selective survival with selective mating (Darwin having distinguished “natural selection” from “sexual selection”). In presenting his point (4) Barash referred to “competition among individuals” (a phrase that I did not quote above), suggesting that he was referring just to selective survival; but he had just referred to both selective survival *and* sexual selection—so that it is unclear if Barash wished to refer to both,

¹¹³. *Sociobiology and Behavior*. New York: Elsevier, 1977, pp. 10-11. Toward the end of the book Barash discussed the concept of a “discrepancy”—a concept with origins, evidently, in the writings of Thorstein Veblen, and dear to those of us who label ourselves as “Restorationists.” Then, in a later book (*The Hare and the Tortoise: Culture, Biology, and Human Nature*. New York: Viking Penguin, Inc., 1986) Barash ostensibly developed that concept—but not very well, in my opinion.

2. Mayr's Interpretation

The late Ernst Mayr has been one of the most respected names in evolutionary biology for some time; thus, his summary of Darwin's theory of monotypic evolution should be taken seriously. It is as follows (except that I omit his graphics):

First, Darwin began by recognizing three “facts”:

Fact 1. Populations tend to grow, and at an exponential rate.

Fact 2. (But) populations tend to remain stable in size.

Fact 3. There is a finite “carrying capacity” for a given species in a given area.

From these three “facts” Mayr claimed that Darwin derived:

Inference 1. A “struggle for existence among individuals” occurs. (Although Mayr did not clarify the meaning that he was giving “struggle for existence” let us assume that he meant to say that intra-specific competition occurs.)

Inference 2. There is differential survival; that is, some of those born die, others live—i.e., there is “natural selection.”

This second inference, according to Mayr, was drawn from Inference 1, along with Facts (4) and (5), which are as follows:

Fact 4. Each individual is unique (i.e., there is population variability).

Fact 5. Much of the individual variation is heritable.

Inference 3. Over many generations the change is such that one can say that there has been [monotypic] evolution.

I assume that this is an accurate translation of Darwin’s theory of natural selection, but will note several problems with Mayr’s summary (and/or the theory it summarizes):

- The meaning of “struggle for existence” is left ambiguous (as to precisely what it entails).
- Mayr’s Inference 2 fails to make clear the point that “differential survival” means that selectivity in (premature) deaths occur—i.e., the survivors (as a group) differ, genetically, from the non-survivors. For only then does the occurrence of (premature) deaths have genetic significance. If, e.g., such deaths simply occur on a random basis, they have no genetic significance (i.e., they are inconsequential for the future genetic composition of the group in question).
- The conclusion (that I am imputing to him) that excess births will *inevitably* result in

intra-specific competition ignores the very real possibility that, e.g., predation will be the primary factor acting to reduce the population to a “proper” size (i.e., carrying capacity level) rather than (or in addition to) intra-specific competition. Evidently Mayr was not aware of the “definition” of “Ecology: that some ecologists would give: “Ecology is about who eats whom.”

- Even if predation is not involved, excess births need not result in intraspecific competition; they could, rather, simply result in death via starvation.
- The theory proceeds as if the environment were non-existent!

Because the Mayr summary of Darwin’s theory of natural is insufficiently clear and detailed, I have taken the liberty of developing a more adequate re-statement of the theory:

3. My “Translation”

(NOTE: There is some repetition below of assumptions stated earlier, but the repetition is done for the sake of completeness in presenting this particular model.)

The Setting

1. Assume a homogeneous area—i.e., one with a level topography, and uniform vegetation. What “uniform vegetation” means here is that the vegetation mix within a circle of given (but unspecified) diameter is the same at one location as it is at any other location within the given area.
2. Within this hypothetical area there are diurnal and seasonal variations in atmospheric conditions (temperature, humidity, precipitation, wind conditions, etc.), but there is not *annual* change: One year is like another (so that the area can meaningfully said to have some definite—but unspecified—*climate*). Put another way: The area is experiencing no global warming! (Note that by “assuming away” environmental change over time, that factor *cannot* be one that causes species change.)
3. The environment of this hypothetical area is a “given” for occupants to be placed in the area. This means that the environment (potentially) influences those individuals (in unspecified ways), but those individuals do not, in turn, influence (i.e., *change*) the environment.¹¹⁴ In fact, the environment influences occupants in a rather peculiar way: It influences individuals in the sense of providing them with sustenance, but does not influence the species (singular) in its development over time (i.e., does not place constraints on development). Darwin’s model totally ignores what I have termed “livability fitness, and deals with “survivability fitness” only to a limited degree. (These terms are explained in the next chapter.)

¹¹⁴ I hope that [James Lovelock](#) does not read this, for as a proponent (indeed originator) of Gaia theory, he would argue that the causation is both ways.

Initial Definitions:

4. T_1 A certain (but unspecified) time of year.
5. T_{11} That time of year for Year 1; this point in time is the starting point for the “model” presented here.
6. T_{12} That time of year for Year 2.
7. T_{1n} That time of year for Year n.
8. T_2 A mating season. (So far as I have been able to ascertain, Darwin did not assume a mating season; I assume a mating season here because I see no way to get Darwin’s model to “work” without such an assumption.)
9. T_{21} The mating season for Year 1 (this assumed to have a “short” duration).
10. T_{22} The mating season for Year 2.
11. T_{2n} The mating season for Year n.
12. T_3 A birthing season. (So far as I have been able to determine, Darwin did not assume a birthing season; I assume such a season because I see no way to get Darwin’s model to “work” without such an assumption, in conjunction with that of a mating season.)
13. T_{31} The birthing season for Year 1 (also assumed to have a “short” duration). (Note that this implies a gestation period of less than one year.)
14. T_{32} The birthing season for Year 2.
15. T_{3n} The birthing season for Year n.
16. B_{31} The number of births occurring during Year 1’s birthing season.
17. B_{32} The number of births occurring during Year 2’s birthing season.
18. B_{3n} The number of births occurring during Year n’s birthing season.

An Identity:

19. $B_{31} = B_{32} = B_{3n}$

More Definitions:

20. P_{11} Population of the given area at T_{11} . (This refers to the *given* species only, not to *all* species.)
21. P_{12} Population of the given area at T_{12} .
22. P_{21} Population of the given area at T_{21} (the mating season of Year 1).
23. P_{31} Population of the given area at T_{31} (the birthing season of Year 1).
24. cc Carrying Capacity (i.e., the number of individuals of a given species that can be supported by the given area for any given period of time—e.g., a given week).

Assumptions:

25. Deaths occur at a constant rate from T_1 to T_2 to . . . T_n . Those occurring with “adults” are all assumed to be attributable to “old age.” (An “adult” is defined here as any individual other than a “just-born” one.
26. The carrying capacity of the given area is assumed to be a constant that does not vary over time; this means that the given species’s occupance of the area is assumed to *not* affect the area’s carrying capacity. So that although the environment of the given area affects (in the limited way specified under point 3 above) members of a given species occupying that area, members of the given species do not, as a consequence of their activities, affect the environment—its carrying capacity in particular.

By definition, the population of the given area cannot exceed the area’s carrying capacity. The point stated under [20] above also applies here: Reference is being made to a given species only.

The term “carrying capacity” refers, of course, to food available in the given area that is consumed by the species in question. For simplicity, we assume that the species in question—let us refer to it as Species X—is some sort of animal species, and lives by consuming members of Species Y, and only members of that species. Let us assume that Species Y is a grass species, so that the Y “individuals” involved are blades of grass—and Species X individuals are herbivores. Given our assumption that the carrying capacity of the given area remains unchanging over time for Species X, the implication is that whatever quantity of grass is consumed by Species X during, e.g., a given day is replaced through natural growth by the next day. Let us assume here that individuals of Species X feed once a day, and that all individuals of Species X (regardless of age, etc.) consume the same amount of grass, and do so day after day. During the period between feeding times the amount eaten is replaced via natural growth, I assume. Further, let us assume that each day all or most of the grass in the area is consumed—but that by the next day’s feeding time is replenished. That is, when the population is P_{11} (or P_{12} , etc.), all of the available grass is eaten each day; but as the population is reduced by deaths (these all attributable to “old age”) during the course of the year, because each individual

is assumed to consume a fixed quantity of grass day after day, during the course of the year less and less total grass is consumed daily—until the birthing season occurs.

An Assumption Regarding the Introduction of Species X Into the Area:

We next assume that individuals of Species X will be introduced into the given area, these individuals being of varying ages, such that:

27. $P_1 = cc$

That is, the number of individuals to be introduced will be equal to the carrying capacity of the area.

An Inequality:

28. $P_{11} > P_{21} > P_{31}$

This follows from the fact that deaths have occurred during this period of time, but no births.

Another Assumption:

29. Individuals of the given species born during a birthing season receive no parental (or other “adult”) care: they are “on their own” from birth on. (Note that “adult,” as used here, refers to “non-infant.”) Also, a given individual of the species is assumed to seek food for itself, but only for itself: Selfish behavior is assumed as “natural.”¹¹⁵

The Introduction of Species X Individuals Into the Area:

Given these assumptions, let us now introduce into the given area a number of individuals of Species X, such that the number = P_{11} (which, per point 24 = cc). We assume that the individuals being introduced vary in age—so that by T_{21} (the mating season of Year 1) some have already died (meaning that the area, at that time, is no longer being occupied at a carrying capacity level). Still later (at the beginning of T_{31}), the population is still smaller; but because the birthing season is about to begin, new individuals will soon be added to the group. We now add a further assumption—which is actually a logical conclusion from the assumptions so far stated:

The Situation at the End of B_{31} :

30. $B_{31} + P_3 > cc$

That is, although the number of “adults” (interpreted here as “non-infants”) has been reduced from T_1 to T_3 as a result of deaths (presumed to have occurred as a result of, and only of, “old age,” so far as “adults” are concerned), the number of births plus that

¹¹⁵ An extremely important point here is that *selfish* behavior is a mere *assumption* of the model, *not* a *conclusion*.

number exceeds the area's carrying capacity. **This situation cannot, by definition, remain for long.**

A Further Assumption:

Before exploring the implications of the fact **bolded** above, let us add a further assumption:

31. Adults are assumed to vary genetically: They differ in characteristics, and these differences are attributable to both genetic differences and experience differences (and even other factors?). Because adults vary genetically, their progeny also so vary in characteristics. Variations in progeny characteristics are attributable solely to genetic variations, given that just-born have had no other factors affect them (ignoring here the possibility that variations in womb experience can be such a factor—but not with a grass species!).

Conclusions and Commentary:

Given the discussion under point [26] above—and specifically the assumption that the given area's carrying capacity, although varying during the course of a day (because of feeding by members of Species X during a certain feeding time), does not vary from day to day, or year to year—it follows that members of Species X—their numbers now increased by the addition of an unspecified number of just-born—will, as a group, during their feeding time still consume the same amount of grass. Let us assume that all members of Species X, regardless of age, consume the same quantity of grass during a given feeding period, and that this quantity is a temporal constant—i.e., it remains the same day after day, year after year.

Note that we have a problem here. Keep in mind that under point [26] we assumed that individuals of Species X consume, during a given day, all of the grass that exists in the given area (with the exception noted). With the population of Species X now larger than the carrying capacity of the area, and it being assumed that each individual of Species X (regardless of age) consumes the same amount of grass daily, this means that not all of the individuals of Species X will obtain grass for their sustenance. In other words, some must die. The question now becomes: Which individuals of Species X, and why?

We know that all of the individuals vary genetically, that “adults” also vary in acquired characteristics, and that the just-born differ from “adults” in that their genetic potential has not yet been realized. That is, although the just-born are all different genetically, each of the just-born is genetically “programmed” to go through a certain maturation process involving not only physical growth, but physical development.

Given that all members of Species X—whether “adult” or just-born—need grass for sustenance (and all are assumed to consume the same amount daily), but the food supply (i.e., grass) is limited, individuals of Species X are now forced to “compete” for food [an implication of point 27]. The adults—regardless of characteristics (and whether differences have a genetic or other basis—have (except for the very old) an advantage in this competition (whatever it is that that entails), simply because they are larger and more fully developed. Therefore, we would expect

that most, if not all, of the deaths that occur now as a result of intra-specific competition during this birthing period would occur in the just-born group.

The number that would *survive* from this group would equal x , where (assuming that the reference is to Year 1):

$$x = cc - P_{13}$$

This equality exists given that $P_{13} + x = cc$, with all (or most) of those dying being the just-born. (Note that the population value—i.e., number—associated with P_{13} refers to the population just before the birthing season begins.)

Which of the just-born would survive? Those who have (inherited) traits that give them the most advantage in competing. What specific trait(s) would that be? At one point (p. 66) Darwin declared that “the vigorous, the healthy, and the happy [yes! he actually wrote that!] survive and multiply.” But should we accept this (curious) assertion by Darwin? Was he being serious in making in making this statement?! Is it a conclusion that logically follows from the “fleshed out” version of his theory, as presented above?

Darwin’s reference to “struggle for existence” seemingly suggests (along with other statements in *Origin*) that he was basically referring to intra-specific competition, and I believe that it is accurate to state that most readers of *Origin* have so interpreted “struggle for existence.” Assuming this to be a fair interpretation of “struggle for existence,” the question arises: What does intra-specific competition *entail*? We need to be able to answer that question before we can address the question of what attributes “winners” would be expected to have.

I will suggest here that there are at least two different possible intra-specific competition scenarios. With one scenario food is near at hand, and individuals need to fight conspecifics to acquire the food they need to live; so that with this scenario the strongest/largest would survive (an approximation of Darwin’s “vigorous” and “healthy” individuals). They survive by preventing conspecifics from obtaining the food at hand. With a second scenario, however, food is not as readily at hand, so that individuals with the most swiftness (perhaps combined with strength/size) would be the winners/survivors.

During the period from T_{31} to T_{12} there will be no births, but will continue to be deaths. Let us again assume that they are all attributable to “old age.” When T_{12} rolls around, however, the population will be slightly less than it was at the beginning (i.e., point in time T_{11}). But also the population will differ in one or more characteristics. Whatever trait(s) it was that gave the surviving just-born a competitive advantage (let’s refer to it as Trait F) will now be better represented in the population. Assuming that Trait F is one that can be measured on a continuous scale (so that a mean value can be determined for time T_{11} as well as time T_{12} , etc.), the mean value will be larger at T_{12} than it was at T_{11} . In addition, it is conceivable (Darwin, in fact, mentioned this possibility on p. 12) that certain traits will be highly correlated (either positively or negatively) with Trait F, and therefore *also* show increase (if positively correlated) or decrease (if negatively correlated) during the same time period. I should also add that if we assume the first of the two scenarios referred to above (food readily at hand), that *aggressive*

behavior might be an expected outcome—but that this may be a result of the *situation* individuals find themselves in, rather than a genetic proclivity on their part. In other words, we would expect that besides having certain physical traits, the “winners” would tend to be the more aggressive individuals, behaviorally. This being the case, the expectation is that aggressiveness would increase in the group over time—but only insofar as it had a genetic basis..

Note that one could now create a graph with time as the X axis and a measurement scale (for Trait F) as the Y axis, and could plot the values for T_{11} and T_{12} as points on the graph. (The next chapter contains many graphs, including this type.) And if one has comparable values for later years, one could do likewise. The points will “line up,” such that the “line of best fit” will show slow, steady, progressive increase. (Keep in mind, however, that the line would be somewhat misleading because what it would suggest concerning change during the *interstitial* periods would be false in the sense of being contrary to what has been assumed in the previous discussion. Also, keep in mind that if we assume Darwin’s “blending theory” of inheritance being used in the model, the upward-sloping line in question here would not be a straight one—as Fleeming Jenkin implicitly suggested in an 1867 article (a point noted earlier).

During the course of a given year (in Darwinian thinking), then, there is a certain process (or group of processes) occurring, and the pattern for one year gets repeated the second year, the third year, . . . the nth year. Given this, if for a given time of year one obtains a mean value (or percent, if individuals have been measured using a nominal scale) for each of a succession of years, and then plots these mean (or percent) values on a graph, one will find that they “line up—and, in fact, do so in terms of a straight line (one can infer from what Darwin wrote—who was, though, wrong about this, given his assumption of “blending”). Each year there has been “natural selection” (this occurring during the birthing season—a period that Darwin never mentioned, but one that one must identify to make his model “work”); this occurs each year because it is “natural” for there to be “excess” births with any given species for, after all, this is what “Rev.” Thomas Malthus claimed—on the basis of no evidence!); and because it occurs year after year, the species in question changes in genetic characteristics—and will continue to change indefinitely in a slow, steady, progressive manner (a conclusion that is highly questionable, even using contemporary assumptions regarding heredity in the model).

This, then, is a “fleshed out” version of Darwin's model of natural selection—stated in a much more explicit manner than was done by, e.g., Ernst Mayr. It consists of a series of logically-connected assumptions, some dealing with change over time, that together “predict” that for a certain year there will be a certain average value for that year, which value will be greater the next year (when determined for the same time of year), etc. Note that the model predicts *quantitative* change, but not *qualitative* change. Given this, can one say that it is a model of *monotypic evolution*—or is it just one of species *change*?

Darwin saw intra-specific competition as an inevitability, given his assumptions. It is true that in *Origin* Darwin referred, e.g., to (p. 53) a plant on the edge of a desert struggling for life against the drought. But although struggle against the environment was something that Prince Peter Kropotkin [1842-1921] emphasized around the turn of the twentieth century, for Darwin the “struggle for existence” usually meant a struggle with conspecifics. Darwin claimed (also on p. 53) that he was using “struggle for existence” in “a large and metaphorical sense including

dependence of one being on another, and including (which is more important) not only the life of the individual, but success in leaving progeny.” In fact, however, the central meaning Darwin gave (in *Origin*) to “natural selection” and “struggle for existence” were as I have specified here.

Note a basic logical problem here, though: What is assumed for Species X does not apply for Species Y (the grass eaten by members of Species X)!! One can, indeed, infer (I believe—and argue in the next chapter) from the above discussion that Species Y would remain the *same* over time! Given this, the Darwinian model of natural selection should not—and indeed *cannot*—be thought of as being a general theory! And the fact that it virtually ignores the environment within which Species X and Y exist—in effect assuming that an environment *is* there (for it provides food), but also *not* there (for it ignores, e.g., Livability Fitness—a term clarified in the next chapter)—makes it a curious theory indeed. Given, though, that it is not my intent in this chapter to present a full critique of Darwin’s “theory” of natural selection—my intent being, rather, to present Darwin’s natural selection model as one among several—having accomplished my goal as well as I am able, let us turn next to a “placement” operation in which I “place” Darwin’s “natural selection” in the context of other selection models., as follows:

A Classification of Selection Models

- I. Environmental Stasis
 - A. Mechanisms causing premature deaths (selective survival)
 - 1. Mechanisms acting continually
 - a. Environmental selection
 - 1) Livability Fitness Model 1
 - 2) Survivability Fitness Model 2
 - a) Success in acquiring food
 - i) Predator Model 3
 - ii) Scavenger Model 4
 - b) Success in avoiding becoming prey (and thus food)
 - b. Darwinian natural selection Model 5
 - 2. Mechanisms acting sporadically
 - a. Accidents Model 6
 - b. Disease Model 7
 - c. Natural disasters Model 8
 - B. Sexual Selection
 - 1. Female choice Model 9
 - 2. Male choice (“harem”) Model 10
- II. Environmental change
 - A. Regular Model 11
 - B. Irregular Model 12

Chapter 9. Putting “Natural Selection” in its Place

One does not need to delve very deeply into the hardcopy/electronic literature—professional and otherwise—on natural selection before one discovers two paradoxical facts:

- One has gone “through the looking glass” (to allude to [Lewis Carroll’s](#) classic). That is, one has entered a realm in which different writers each give “natural selection” a meaning (explicitly or implicitly) that may be unique to that writer. In other words, one has entered a world in which “natural selection” is given a variety of meanings.
- One has entered a realm in which “natural selection” is frequently used without any indication of the specific meaning being attached to the term—as if its meaning is so obvious as to not require specification. But the impression given in such cases is that the writer is using the term as an *excuse* for not specifying the mechanism responsible for temporal change observed with some given species—and/or to lend an aura of importance, sophistication—even untouchability—to his or her work.

I will not hazard a guess as to why this situation exists. My starting point, rather, is with the recognition that it *does* exist, and conviction that it *should not*. (In fact, I can anticipate the day when the term will no longer be used, except in, e.g., historical discussions of Darwin!)

Several assumptions underlie the presentation that follows, among them:

- Several different mechanisms operate in nature (so far as species change is concerned), each with its own particular effects on a given species.
- Each such mechanism warrants its own unique name.
- “Natural selection” should not be thought of as a blanket term but, rather, should be associated with but a single specific mechanism.
- Any given species will be simultaneously affected by more than one mechanism.
- Given this latter fact it is not necessarily easy to infer from real-world temporal data the mechanism(s) that explains the data.

Although all of these assumptions (and perhaps others as well) underlie my presentation, I limit the scope of the discussion to two objectives:

- Identifying the principal mechanisms that may be operating, over time, in the real world relative to species (plural)—the mechanism associated with natural selection having already been identified in previous chapters, and therefore given but passing notice in this chapter.
- Further clarifying the meaning of “natural selection”—by putting “natural selection” in the context of a number of other selection mechanisms, and illustrating natural selection with

graphic material.

Mechanisms are discussed herein using a “modeling” approach. My use of that approach here draws its inspiration from the work of pioneer modeler Johann Heinrich von Thünen [1780-1850], whose classic *Der isolierte Staat* (first published in 1826) introduced explanatory-predictive modeling to the world. Although Thünen's classic work was published (in German) long before Darwin's *Origin* (1859), Darwin evidently was unaware of the book (which, though, was not translated into English until 1966!). Whether Darwin would have benefited from exposure to Thünen's pioneering work, though, is a matter of conjecture; for although Darwin himself engaged in some “thought experiments,”¹¹⁶ he seemed to be more comfortable in the realm of factual data than that of modeling and theory.

A “model”—as herein used—consists of a set of statements (“assumptions”) regarding the factors/variables thought to explain something, along with the statement(s) “produced” by that set of statements. It is useful to refer (as noted in Chapter 5) to the “explaining” statements as constituting the *explanans* portion of the model, and the “explained” statement(s) as the *explanandum*. The *explanans* can be thought of not only as “explaining” the *explanandum*, but *producing* it, or *predicting*—so long as one understands that “prediction” here is often thought of in a *timeless* sense. Structurally, a model is similar to a theory in that the statements constituting the *explanans* are usually thought of as having some degree of generality; however, those statements are explicitly thought of as “merely” assumptions, rather than empirical laws. Which is not to say, however, that (observational¹¹⁷) scientists create models simply as a pastime. For the ultimate goal of scientists engaged in modeling work is to “operationalize” their models to the point where model predictions match¹¹⁸ empirical observations “well.”

My “strategy” here is—referring to the classification of models presented at the conclusion of the previous chapter—to present each of those 12 models, in the order listed in that classification, a total of 12. I regard those 12 as exhausting the (significant) possibilities. This is not to say, however, that other additional models are not possible, for each of the models could be “complexified” in various ways (e.g., by combining several of the models together), yielding a potentially huge number of models. A qualification that should be made explicit at the outset here, though, is that all of the models identified and discussed below are *monotypic*, rather than *polytypic* in scope.¹¹⁹ That is, they are models that focus on change (or lack of such) with a

¹¹⁶ . For example, in his Chapter IV (“Natural Selection”), Darwin asked (p. 75) for “permission to give one or two imaginary illustrations.”

¹¹⁷ As opposed to experimental.

¹¹⁸ Match in a *similarity* sense, not a *correlational* one; there is a difference!

¹¹⁹ I have borrowed these terms from William Tammone, “Competition, the Division of Labor, and Darwin's Principle of Divergence,” *Journal of the History of Biology*, Vol. 28 (Spring 1995). Tammone used these terms on pages 116, 120, and 131. Parallel terms are (respectively) *anagenesis* and *cladogenesis*. See, e.g., Stephen Jay Gould, *Full House: The Spread of Excellence From Plato to Darwin*. New York: Harmony Books, 1996, p. 63.

single species, not the emergence of new species from existing ones. “Evolution” is most commonly thought of in the latter sense, but the discussion herein focuses solely on monotypic evolution. In addition, I should note that most of the models are unrealistic in the sense that they include just one mechanism: In the real world this is rarely, if ever, the case.

Actually, it would be more accurate to state that my focus here is on models of monotypic *change/development* rather than monotypic *evolution*. For if one thinks of monotypic evolution as involving not just *quantitative* change but *qualitative* change, I must note that the models discussed herein involve quantitative change *only*—and therefore perhaps should not be thought of as *evolution* models. The assumptions of the models (stated below) are such that when their “predictions” are graphed, the resulting line is not necessarily linear, meaning that indefinite change (which would suggest that monotypic *evolution* is possible) is not necessarily being predicted.

As there are some assumptions that underlie most of the models that are discussed below, I begin by identifying those assumption, and then follow that presentation with a short one concerned with the concept of “fitness.”

A. Assumptions Underlying All Models

Certain assumptions underlie all of the models (with exceptions noted), and I put these into two groups, groups A and B. It will be useful next, then, to present those underlying assumptions.

1. Group A Assumptions

Assume a group of individuals of a certain species (assume specifically an animal species), and assume further that the group has not yet been “placed” into a “model environment.” In addition, assume that:

- With any conceivable variable (except sex), measurements (of individuals) will be accomplished using a continuous scale (rather than, e.g., a nominal one, or the absolute scale of counting numbers).¹²⁰
- With any conceivable variable (other than “sex., of course), the values obtained (for individuals) at any given point in time will form a normal distribution when graphed (if it is relevant to create a histogram from the values). See Figure 12 (top of next page)—which depicts a normal distribution:

¹²⁰ The lone exception is the variable “sex”—in that the nominal scale is used with that variable, with “male” and “female” being the only two categories recognized.

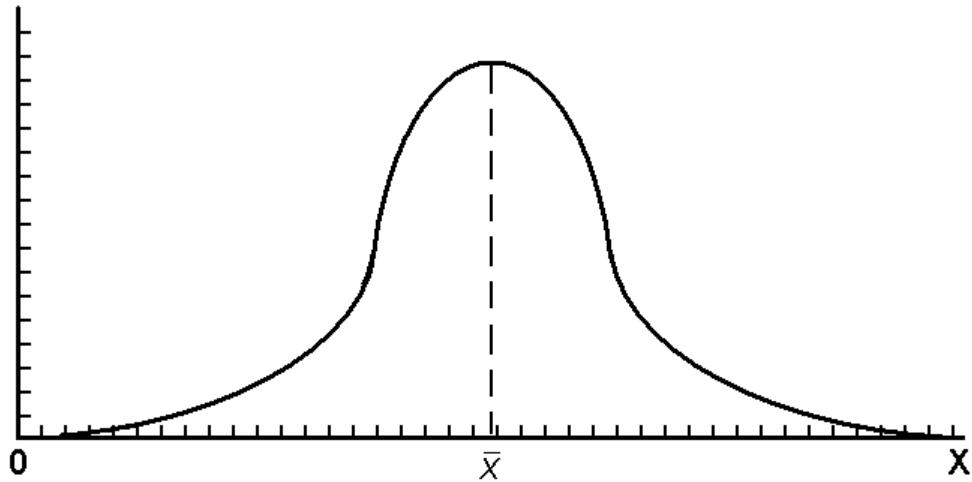


Figure 12: The Bell Curve

- A mean and standard deviation can, therefore, be determined for a set of values for any given variable.
- The various variables for which values can be obtained are not necessarily correlated one with another: The range of simple inter-correlation coefficients could vary from +1.00 to 0 to -1.00.
- Half of the individuals born during a given period (e.g., a year) will be male, half female.
- All individuals of the species are born with an urge to eat/drink, an urge to engage in behavior to satisfy that urge, and the capacity to act on the urge. These attributes are uniformly present in individuals (i.e., present with the same strength in each individual, and continue at that strength through time).
- All individuals reach sexual maturity at the same age, and at that age develop an urge for sexual activity with members of the opposite sex; this drive is uniformly present in individuals (i.e., present with the same degree of intensity in all individuals, that degree of intensity remaining constant over time).¹²¹
- All adults are assumed to be fertile, and to produce progeny (except in the sexual selection models). In addition, all adults produce the same number of progeny—for most models a replacement level will be assumed, removing the factor of intra-specific competition from all models except the natural selection one).

¹²¹ This assumption is not intended as a slight of homosexuals. It is made, rather, to keep the model simple. It is a usual practice with model builders to begin with simple—and therefore tractable—assumptions, and then gradually “complexify” the model until its predictions reflect the real-world situation as closely as possible.

- All individuals eventually die—an assumption necessary if evolution is to occur (as [August Weismann](#)¹²² has noted). (Weismann’s view here is likely correct, but I need to repeat that the models presented herein are models of monotypic *development*, not monotypic *evolution*.)
- Although age of death varies from model to model, there is a certain (but unspecified) *maximum* length of life.
- If a male mates with just one female during his lifetime, and a female mates with just one male during her lifetime, the mate involved will be similar in that both will be on the same percentile for any given variable.¹²³
- The offspring produced by a given couple during their lifetimes will vary in observable characteristics, some
- The offspring produced by a given couple during their lifetimes will vary in observable characteristics, some being on a higher percentile with a given variable than the parents, some on a lower percentile (this variation having a genetic basis). Their mean for any given variable will approximate the value for either parent for that variable.
- The range in values for a given couple’s offspring for any given variable will be approximately the same as that for all other couples.

Given these assumptions, certain questions arise: Assuming that the group is introduced into some given (model) area, what would we expect to happen to that group over some given period of time under different assumptions (i.e., in response to different mechanisms)? That is:

- *What* variables will be affected?
- *How* will they be affected (if they are)?

Before these questions can be addressed via a series of models, it is, however, necessary, to introduce a second set of assumptions underlying all of the models (with exceptions noted). These Group B assumptions are as follows:

2. Group B Assumptions

- The area into which individuals of the given species is to be introduced is left undefined in size, but is assumed to consist of contiguous territory.

¹²² . See Noel T. Boaz, *Evolving Health: The Origins of Illness and How the Modern World is Making Us Sick*. New York: John Wiley & Sons, Inc., 2002, p. 222.

¹²³ The two sexual selection models discussed below use different assumptions.

- That area is assumed to be spatially homogeneous in its physical characteristics—i.e., in its elevation (so that, therefore, it has a flat topography), climate, soil, etc. The requirement of homogeneity does not preclude the possibility of some variety within the given area, however. For example, we could assume that the mix of vegetation within a circle of x radius within the area would be the same regardless of where the circle would be placed within the area. Note that given the assumption that the environment is a spatial constant, it cannot be a factor influencing spatial variation in the species in question; indeed, such spatial variation should not occur for any reason. Note also that although, e.g., climate is assumed to be the same in the given area year after year, this does not mean that there are not diurnal and seasonal variations in atmospheric conditions within the area; indeed, such variations are taken for granted—and are assumed to normally follow a certain pattern during the course of a year (so that, therefore, the area can be said to have a certain *climate*).
- The area has a “permeable” boundary (unlike, e.g., an island); therefore, migration into and out of the area can readily occur. It does *not*, however.¹²⁴
- The population of the given species is assumed to be constant from year to year. That is, the population at T1 = the population at T2, etc., where T refers to a certain time of year (i.e., date—such as January 1). This does not mean that there is not fluctuation in population size between, e.g., T1 and T2; but at no point in time is the population greater than the carrying capacity of the given area: By definition, it cannot be! That is, P is basically equal to cc, where P is the population at any given time, and cc is the carrying capacity for the species in question.¹²⁵ I say “basically” because before a birthing season (see the “translation” I offer at the end of Chapter 8) the population would reach its low point; but even at that point in time the population would be close to a carrying capacity level.
- Parental (or other adult) care of the just-born is disallowed.¹²⁶ That is, a “just-born” individual of the given species is “on its own” upon birth—the underlying assumption here being that selfishness is a universal (and inherited) characteristic with the given species.¹²⁷ It is virtually essential for survival!—although *not* assuming it would not

¹²⁴ This assumption obviously lacks in realism, in that a common Astrategy@ used by many species (e.g., of birds) is to migrate from one area to another as atmospheric conditions change. The role of migration is often ignored in discussions of adaptation, but see Niles Eldredge, *Reinventing Darwin*. New York: John Wiley & Sons, Inc., 1995. Indeed, Eldredge asserts (p. 78) that species tend to change their locale—rather than anatomical features—in response to environmental change.

¹²⁵ The given area’s carrying capacity for a given species is assumed to be a temporal constant—meaning, e.g., that it is unaffected by the given species’s occupancy of the area—an assumption that would, of course, utterly lack in realism in the case of humans!

¹²⁶ Therefore, the species in question might be referred to as an “r-selected” one. Boaz, *op. cit.*, p. 45.

¹²⁷ I assume this (i.e., selfishness) not so much because I think such an assumption has realism (because I *don't* assume that!—and will comment on the matter later), but because it has “tractability,” thereby

necessarily mean that the species could not survive.

- The initial models (i.e., the first four) assume that premature deaths occur only as the result of environmental selection, and environmental selection itself is assumed (for modeling purposes) to be a two-step process, the first step involving selection on the basis of “livability fitness,” the second “survivability fitness” (these concepts defined shortly).
- For a certain point in time (e.g., January 1) for a given year, observations (for various variables) are assumed to be made on the individuals of the given species then living in the given area, with those observations then being aggregated, and a mean being determined. When these quantitative values are determined for a given variable for a series of years, plotted as points on a graph, with the points then connected with a line, the value associated with a given point is assumed to reflect the genetic character of the population at that point in time, not non-genetic (i.e., physiological) adaptation¹²⁸ on the part of the individuals comprising the species in the given area.

Another topic that requires attention before the models can be presented is that of *fitness*.

B. Fitness

Fundamental to a discussion of environmental selection (I.A.1.a. in the above classification) is the concept of fitness. The term “fitness” has currency in our society in the term “physical fitness;” but the meaning that ‘fitness’ has in that term (i.e., good cardiovascular health, lack of excess body fat, etc.) has little in common with the meaning of “fitness” for the present discussion. Because of that fact—along with the fact that “fitness” in the present context is at least a bi-dimensional concept—it is advisable to precede a discussion of specific models with some clarificatory comments on this matter.

For modeling purposes, it is useful to identify two types of (environmental) fitness, what I call “livability fitness” and “survivability fitness,” and to think of environmental selection itself as a

making models easier to “run.” For a convincing theoretical argument in support of the view that selfishness is not innate in humans see Nancy Makepeace Tanner, *On Becoming Human*. Cambridge, UK: Cambridge University Press, 1981, especially pages 164, 165, and 210. The mechanism used by Tanner in her theory is sexual selection, *not* natural selection. (I summarize her argument in Chapter 11.) Also of relevance are, e.g., Richard C. Lewontin, Steven Rose, and Leon J. Kamin, *Not in Our Genes: Biology, Ideology, and Human Nature*. New York: Pantheon Books, 1984; Alfie Kohn, *No Contest: The Case Against Competition*. Boston: Houghton Mifflin Company, 1986; and Frans de Waal, *Good Natured: The Origin of Right and Wrong in Humans and Other Animals*. Cambridge, MA: Harvard University Press, 1996.

¹²⁸ For example, temporary expansion in lung volume as one ascends to higher elevations (where the air is “thinner”). See, e.g., the “Mechanisms of Adaptation” section in (pp. 106 - 113) Chapter 4 (“Determinants of Health and Disease”) of René Dubos, *Man, Medicine, and Environment*. New York: The New American Library, 1969. First published by Frederick A. Praeger, Publishers, in 1968.

two-step process, with the former type of fitness preceding (logically and temporally) the latter type. For definitional purposes, however, it is useful to begin with “survivability fitness.”

A given individual of a given species can be said to have *Type A survivability fitness* if, first, it has success in acquiring food—either as a predator or scavenger, as the case may be. The assumption in either case, however, is that food is readily available (because, i.e., there are no excess births, in a Malthusian sense—except for the natural selection model), so that (“therefore”—for Darwin, at least) intra-specific competition is not a factor involved in determining whether a given individual succeeds in acquiring food. Rather, other factors determine success, it generally being assumed that individual attributes (these having a genetic basis) determine success/failure.¹²⁹

Second, a given individual of a given species can be said to have *Type B survivability fitness* if it has success in *avoiding* becoming prey to (and thus food for) individuals of other species. In this case it is not necessarily assumed that excess births have occurred (with the predator species in this case¹³⁰); but again, it is generally assumed that the attributes (those that determine success (*avoidance* in this case) are individual ones that have a genetic basis.¹³¹

Livability fitness (already dealt with in Chapter 7) can now be thought of as referring to attributes that enable an individual to live in a given area, assuming away any need to eat/drink, and any possibility of being killed by a predator. In this case it is, first, important to keep in mind that an individual with livability fitness for one area need not have such fitness for other areas. Second, livability fitness itself refers to attributes that an individual has (these assumed to have a genetic basis) that enable it to live in the area in question given that area’s temperature conditions (as they vary through the year), precipitation characteristics, humidity characteristics, wind characteristics, etc. If an individual has “fitness” for a particular area, it will live, *ceteris paribus*; if, though, it lacks livability fitness, it will die at some point after being introduced into the hypothetical area.¹³² Third, the attributes that contribute to livability fitness are not necessarily just physical ones, but may also include behavioral ones (e.g., burrowing a hole for protection against the elements, among other things).

Model 1 has as its focus livability fitness, and assumes—for the sake of simplicity—that the environmental characteristics relevant for livability fitness (such as temperature, etc.) can be

¹²⁹ There are exceptions. For example, a given plant may succeed simply because it occupies a favorable location relative to incoming sunlight.

¹³⁰ Although it helps—for the sake of the predator!

¹³¹ Again, there are exceptions. For example, a group of individuals of a given species may develop a behavioral pattern (e.g., the “posting” of a sentinel) that contributes to *group* survival. This behavioral pattern may have a genetic basis, but may also involve learning—the *ability* to learn having, though, a genetic basis.

¹³² They do, of course, have as an “out” migration to another area, one more favorable for them; but we are assuming away here the possibility of migration.

“bundled” together into one variable—which, for want of a better term, I refer to as “environment” (Variable E). The underlying assumption here, of course, is that the variables so bundled are strongly inter-correlated. That assumption may or may not have *realism*; it does, however, have *tractability*—an important attribute for assumptions in predictive/explanatory models.

Three general concluding comments are in order regarding fitness. First, just because a given individual has fitness, it does not follow that that individual will not die prematurely: Fitness does not guarantee survival (to old age, and a “natural” death). In other words, survival *requires* fitness; on the other hand, however, fitness does not *ensure* survival. Second, the attribute(s) that gives an individual *livability* fitness is not necessarily the same attribute(s) that gives the individual *survivability* fitness. Related to this point is the fact, third, that the attribute(s) that enables an individual to *acquire* food is not necessarily the same attribute that enables that individual to *avoid* becoming prey (food) for individuals of another species. These facts—along with the fact that the various attributes involved need not be correlated—mean that environmental selection is a more complex process than is commonly thought. Indeed, it is not a process at all but, rather, a *complex* of processes. Processes that are, of course, operating simultaneously (i.e., not in the step-like manner assumed for modeling purposes here).

Finally, the fact that the focus of the I.A. models is on survivors (specifically on how their characteristics may vary over time) may suggest that non-survivors play no role in the grand scheme of things, so far as life is concerned; but such a conclusion is only partially correct. For non-survivors—whether they have died prematurely or of “old age;” whether they have died prematurely because of a lack of livability fitness, or because they have been killed by predators—provide *food* for survivors. In other words, what enables the survivors to live is that other individuals (of other species, usually) die¹³³, and thereby provide food for the survivors. Indeed, the discipline of Ecology is often described as a discipline about “who eats whom,” and the implications thereof. It is true that individuals that die prematurely may not (and *will* not, if they are very old) affect the future genetic character of their species. The “sacrifice” of their lives is, however, essential not only for the future genetic character of their species, but for the continuation of life *per se*. “They also serve who only stand and waite”—as someone once wrote¹³⁴

¹³³ Eating by individuals of a given species does not necessarily involve the death of individuals of other species. For example, individuals of a given species may eat leaves of trees, but that does not necessarily (or commonly, for that matter) result in the killing of those trees.

¹³⁴ The last line of [John Milton's](#) “On His Blindness.” Milton wrote this sonnet while blind, and as a commentary on his blindness. Milton [1608 - 1674] later wrote his famous “Paradise Lost.”

C. The Models

Note that a classification/listing of the models is presented on the last page of the last chapter.

Introduction

Given that a number of selection “mechanisms” operate in nature, and that all are (thereby) “natural,” all could be considered “natural selection” models—for all truly are. Because, however, there is good reason for associating a single specific mechanism with “natural selection” as used by Darwin in *Origin*, I defer to Darwin in labeling only Model 5 as a “natural selection” model. Granted that Darwin, in discussing—or even defining—“natural selection,” was never sufficiently explicit. However I have already made some effort of clarification, and will make some additional efforts in this one.

In addition, I should note here that I see Darwin’s concept of natural selection as basically excluding environmental selection: It appears to me that Darwin thought of natural selection as a process that occurred *instead* of environmental selection. My assertion here may be a controversial one; but I discern in Darwin’s discussions (in *Origin*) of natural selection no indication that he thought of natural selection as a mechanism that operated *in addition to* environmental selection (except in his comprehensive model). Did Darwin think of natural selection as *encompassing* environmental selection?¹³⁵ Or, rather, did he fail to recognize environmental selection as a mechanism? My answer is to come down firmly on the view that although environmental selection was a part of his comprehensive model, it was *not* a part of his natural selection model—which (in my interpretation) assumed away environmental change in favor of environmental stasis.

In the “Group B Assumptions” section above I stated the following assumption:

The population of the given species is assumed to be constant from year to year. That is, the population at T_1 = the population at T_2 , etc., where T refers to a certain time of year (i.e., date—such as January 1). This does not mean that there is not fluctuation in population size *between*, e.g., T_1 and T_2 ; but at no point in time is the population greater than the carrying capacity of the given area: By definition, it *cannot* be! That is, $P = cc$, where P is the population at any given time, and cc is the carrying capacity for the species in question.

I need now to add to this assumption that for the first four models (i.e., the environmental selection models) I assume that $P < cc$; that is, a (relatively) constant population level is maintained over time, and that level is somewhere below the carrying capacity level. I use this assumption because I believe that it is a highly realistic one. For the natural selection model, however, I not only assume “excess” births, but assume (as did Darwin, evidently) that $P = cc$ —i.e., that the population level remains constant over time, but at the highest possible level, i.e., a carrying capacity level.

¹³⁵ If so, he thought of environmental selection differently than I do.

Model 1: Livability Fitness

Two facts are preeminent so far as Model 1 is concerned: environmental conditions vary within the given hypothetical area during the course of a year (i.e., variation in E occurs); and individuals vary in their tolerance for different environmental conditions. The latter is herein referred to as “tolerance range” (TR), and defined below.

Specific Assumptions

- The area into which members of the given species is to be introduced lacks members of that species at the beginning point.
- Although at some point the population level (for the given species) will reach level P , the number of individuals of the species *introduced* into the area at the “starting point” is less than P .
- Initially, the birth rate will exceed the death rate—given the assumption, stated earlier, that P is a temporal constant and that the initial population size is less than P (with $P < cc$). Over time, however, the population will grow until it reaches size P ; at that point the birth rate will begin to equal the death rate—yielding constancy in the size of the population. From that point on the deaths that occur will be of the unfit (in the sense of not fitting the environment), of the young (dying prematurely, as a result of their “unfitness”), and of the old (simply from “old age”).
- To reiterate what was stated under the “Type B” assumptions above: Normal environmental conditions are assumed. That is, there is a certain diurnal/seasonal pattern of atmospheric conditions within the given area, and this pattern repeats itself exactly year after year, so that atmospheric conditions are perfectly predictable from day to day, month to month, year to year.
- “Livability fitness” is a function, in part, of one’s TR (defined shortly) and the environmental characteristics of the hypothetical area into which individuals of the given species will be introduced.

Let us begin by specifying those environmental characteristics, using Figure 13 as the basis for that discussion. This “graph” has only an X axis (i.e., abscissa), with the horizontal line indicating E values. Two vertical dashed lines are also depicted in Figure 13, these indicating the extremes of E that occur during any given year—this particular graph indicating a minimum value of 60 and a maximum value of 160.

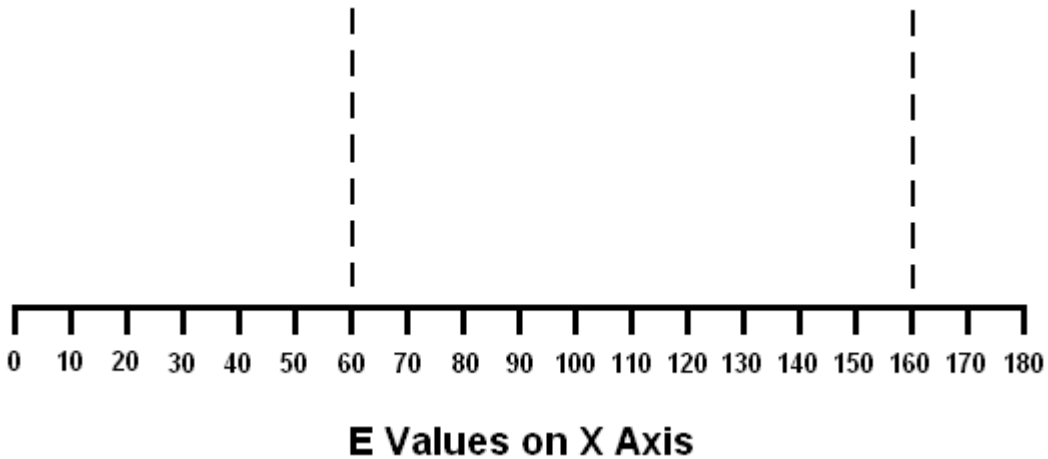


Figure 13: Livability Fitness 1

Let us next take Figure 13, extend the dashed lines vertically, and add horizontal lines, each representing an individual of the given species to be introduced into the given area; in this case each line not only represents an individual, but that individual's TR (tolerance range)—the result being Figure 14 below. The length of a line represents the TR of the individual, and two facts are of interest regarding a given TR: Its *position* relative to the two dashed vertical lines; and (secondarily) its *length*. Length is given by the formula $L = E_2 - E_1$, where E_2 is the maximum E value associated with a particular individual, and E_1 is the minimum E value. What these two values signify are, respectively, the maximum value that a given individual can tolerate, and the minimum value. If, during a given year, the maximum value is exceeded or a value occurs less than the minimum value, the individual in question will die, for lack of livability fitness. The same is true for failing to meet the minimum. Thus, for an individual to survive in the given area, the line representing the individual must lie *entirely* within the two dashed vertical lines.

Note with Figure 14 that with individuals 1 and 5 their TR lines intersect both of the dashed vertical lines, the TR lines for individuals 4, 6, and 9 intersect only the right vertical dashed line, and the lines for individuals 3 and 8 intersect only the left vertical dashed line. This yields the unusual situation that only individuals 1 and 5 have TR values that will enable them to survive in the given area during every season of the year! Depending on the time of year, given the TR values of the individuals introduced into the area, some will die virtually immediately. Also, during the course of a given individual's life, there is the possibility that that individual would die virtually immediately were our heredity assumptions to be changed. Keep in mind that we are assuming that progeny receive no care upon birth, so that there is no possibility of offspring being protected, should they have a TR entirely within the 60 – 160 survival range.

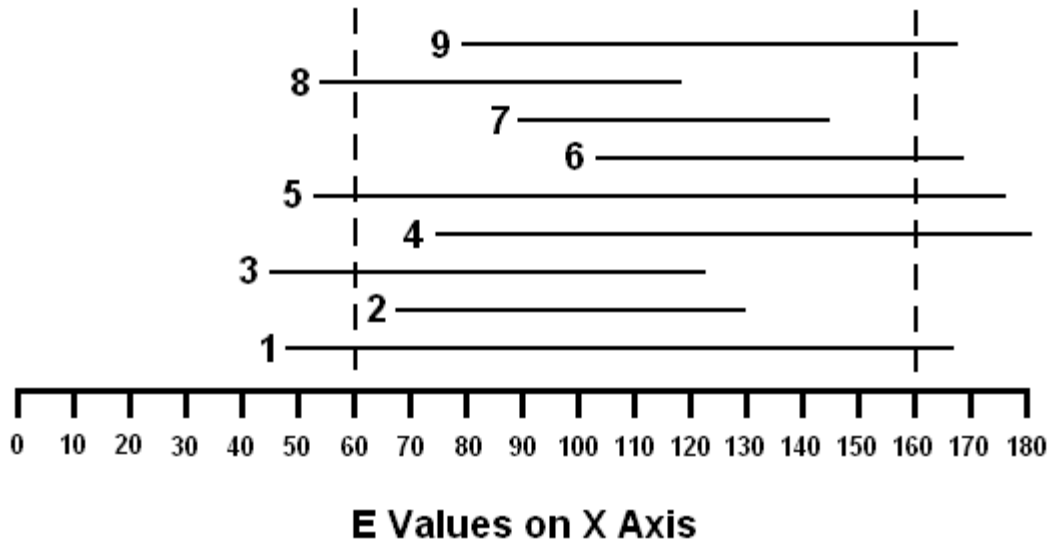


Figure 14: Livability Fitness 2

Note that our model here does not allow us to speak of *degrees* of fitness (which is not to say that that concept is not meaningful, however). For example, the TR lines for individuals 1 and 5 both intersect both vertical lines (meaning that both are fit), but the line for 5 is slightly longer than the one for 1. This means that individual 5 could survive in an area with more *E* variation than could individual 1, but that fact is irrelevant for survival in the given area assumed by the model. With Model 1 there are just two categories of individuals, the fit and the unfit—and there is no basis for distinguishing between “under-fit” and “over-fit” with the unfit (mainly, because such categories do not exist!). The unfit are simply that, period—individuals, i.e., that, given their characteristics relative to the environment, are unable to survive; however, just because they therefore must all die, they do not necessarily do so at the same time. Given our conclusion here, note that the Spencerian/Darwinian phrase “survival of the *fittest*” is meaningless, for one must here think of fitness in dichotomous (i.e., either/or) terms. There is survival of the *fit*, true, in this model; but *degrees* of fitness are not recognized in the model¹³⁶

Note also that although the fit all have an *L* (i.e., length of TR line) value < 100 in our example, it does not follow that *only* the fit have such an *L* value. Meaning that not just the *L* value is relevant for survival in the given area. Also, if a “max-min mean” (MMM) is determined for individuals using the formula $MMM = (E_2 - E_1) / 2$, although a fit individual will have an MMM value close to 110, it does not follow that *only* fit individuals will have such an MMM.

A final point to make regarding Figure 14 is that although it assumes that a given individual can be represented with a line that has a fixed horizontal position, that assumption is not necessarily realistic. For example, the species in question might be one such that as the cold season approaches, individuals of the species grow longer fur—thereby shifting an individual’s TR line

¹³⁶ A qualification must be added here, however: with a model that produces change in the species in question, a species could change to the degree that some of its members lose their environmental fitness, and therefore die. I will illustrate this with Model 8.

to the left temporarily, perhaps enough so that it intersects the leftmost vertical line (making the individual fit, and therefore a survivor). In other words, in nature one finds various kinds of adaptation that “complexify” the concept of fitness!

Let us, finally, bring in the time dimension—which is what we are ultimately interested in here. For a given date (e.g., January 1) let us assume that the MMM is determined for each (living) individual of the given species, and then the mean of those values (what we will call Variable A). Assume next that an A value is determined for a series of successive years (from t_1 to t_2), and that those values are plotted (as points) on a graph. Figure 15 below has time on the X axis, and Variable A (let us assume) values on the Y axis. What is of interest here is that the A value for one year is virtually the same as the A value for any other year. Meaning that if a “line of best fit” were placed through the “cloud” of points, that line would virtually parallel the X axis. Meaning, in turn, that with the assumptions associated with Model 1 little change occurs over time with Variable A.

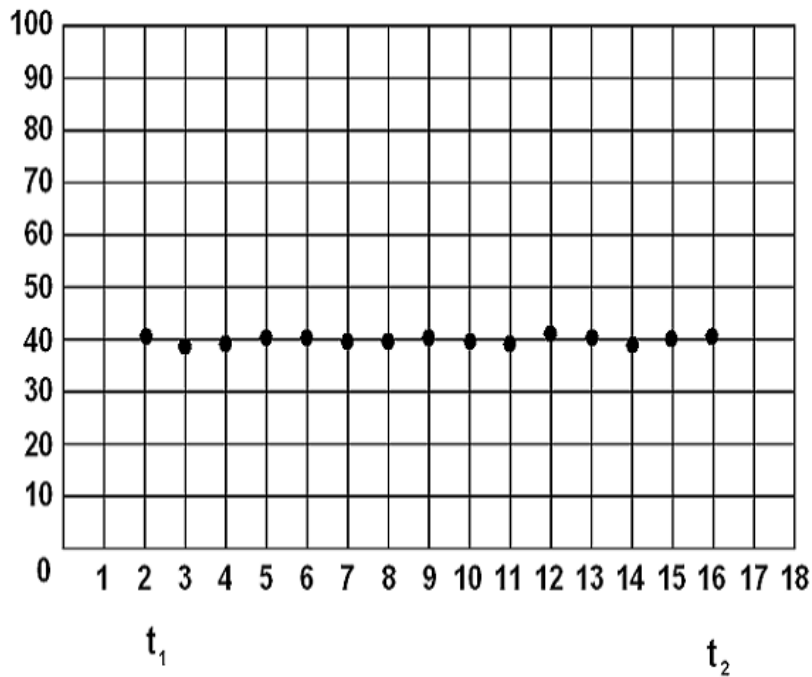


Figure 15: Illustrating Non-Variation (Temporal)

The values that I have plotted as points on Figure 15 are, of course, merely “theoretical” ones, ones that would be virtually impossible to operationalize. It might appear, then that Model 1 has little if any relevance for understanding non-change in the real world. I would argue, however, that if one would take virtually *any* empirical measurement on individuals of a given species in a given area, aggregates those values, and determines that the mean does not change significantly over time, one has a basis for arguing that one has a Model-1 sort of situation. Provided, that is, that one can rule out other possible mechanisms.

Model 2: Type A1 Survivability Fitness

The focus of Models 2 and 3 is on an individual's ability to acquire food as a *predator* (the first model) and an individual's ability to acquire food as a *scavenger* (the second model). The question of whether the individuals involved are *subject* to predation is ignored here.

Specific Assumptions

- Speed (Variable B) is assumed to be necessary for survival (along with Livability Fitness, of course): An individual needs to be able to attain a certain amount of speed in order to survive.
- The speed that an individual is able to attain does not vary with age.
- Individuals, however, vary in their speed.

Assume the following distribution of B values for the individuals to be introduced into the given area:

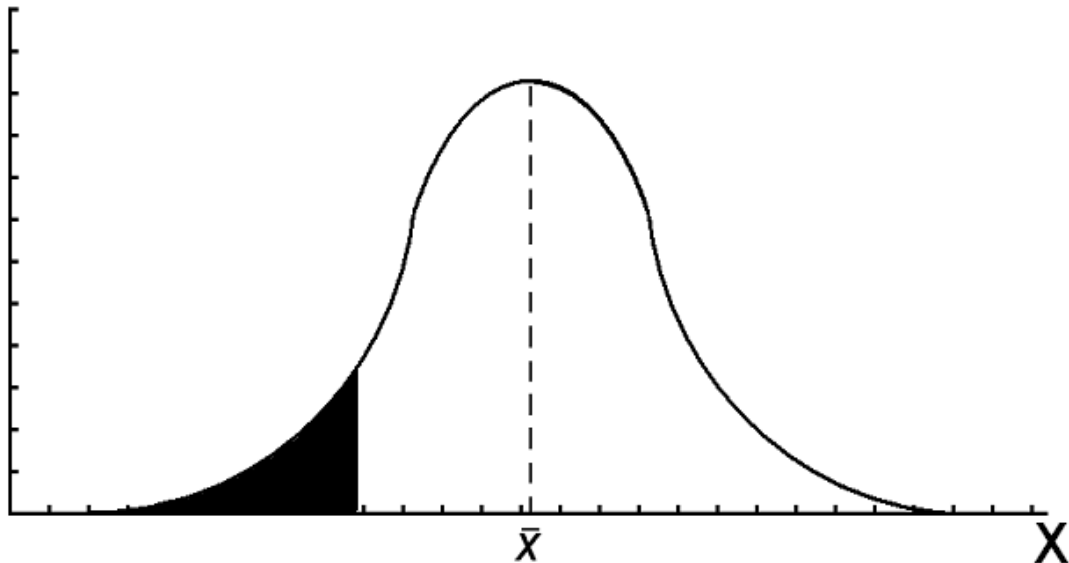


Figure 16: A1 Survivability Fitness: Bell Curve

All individuals with B values (depicted on the X axis) in the blackened “tail” on the left are assumed to have insufficient speed for being successful in being successful predators, are therefore “unfit,” and therefore die (*regardless* of their livability fitness). There are two categories of individuals here, the unfit (in the blackened area) and the fit; however, we can think of speedy individuals as being more “fit” than less speedy ones. Thus, although we can think of individuals in the blackened area as being simply unfit (and therefore doomed to die prematurely), we can think of the other individuals as varying in their *degree* of fitness. Specifically, we can think of the probability of being successful as a predator (and therefore

surviving) as being positively correlated with speed. Thus, rather than saying that “survival of the fittest” would be expected (i.e., either/or thinking—the “fittest” survive, others don’t—we can say that the probability of survival increases with possession of the trait (speed) that confers survivability fitness. Although the “survival of the fittest” concept is not irrelevant here (as with Model 1), it is best stated using *probabilistic* language.

If we now bring in the time dimension, we can first observe that if histograms comparable to Figure 16 were created for a succession of years, one would expect to observe that the left part of the histogram would shift to the right, giving the histogram steeper sides, and shifting the mean to the right. At some point none of those born (with rare exceptions) would be in the blackened portion,¹³⁷ meaning that all would have Type A1 Survivability Fitness—different individuals having, though, different probabilities for continued success as predators. Again, at that point the phrase “survival of the fittest” would be applicable only if rephrased using probabilistic language.

If we graph our expectations for the mean of B over time, the graph would have an appearance much like Figure 17 (see next page).

This graph shows average speed increasing somewhat (and rather steadily) over time—but only to a point: The genetic material assumed for the individuals allows change only to a point. Because factors have not been introduced to cause change in the genetic material, after a certain point change ceases—and we have a situation much like illustrated in Figure 17.

Model 3. Type A2 Survivability Fitness

Like Model 2, Model 3 focuses on an individual’s ability to acquire food, but assumes a scavenger species rather than a predator one.

Specific Assumptions

- Assume that two variables are relevant for success as a scavenger, a physical attribute, strength (Variable C), and a behavioral one, aggressiveness¹³⁸ (Variable D).
- Assume, however, that these variables are perfectly and positively correlated, so that in effect there is but one variable, what we will refer to as Variable C-D.

¹³⁷ In which case the predator in question (which I have assumed away here) would need to find other prey, if it is to survive.

¹³⁸ Elliott Sober has asserted that “The Darwinian idea of individual selection predicts that selfish characteristics will become more common and altruistic ones more rare.” It is, however, more accurate to state that Darwin assumed (if but tacitly) that individuals were “naturally” self-regarding, and concluded (if but tacitly) that natural selection would produce aggressive (animal) individuals (and that such individuals would have a survival advantage). Elliott Sober, *The Nature of Selection: Evolutionary Theory in Philosophical Focus*. Chicago: The University of Chicago Press, 1984, p. 26. However, one can also argue that if aggressive behavior occurs, it could be the result of situational factors rather than heredity—or both factors could be involved, of course.

A histogram for either C or D would look like Figure 16. Again, all individuals with values below a certain point would die (whether or not they had Livability Fitness). The histograms for different points in time would shift to the right as with Model 2, and the mean would change in the same way as with Model 2—resulting in a graph like Figure 17. What was stated regarding the “survival of the fittest” concept in discussing Model 2 also applies here.

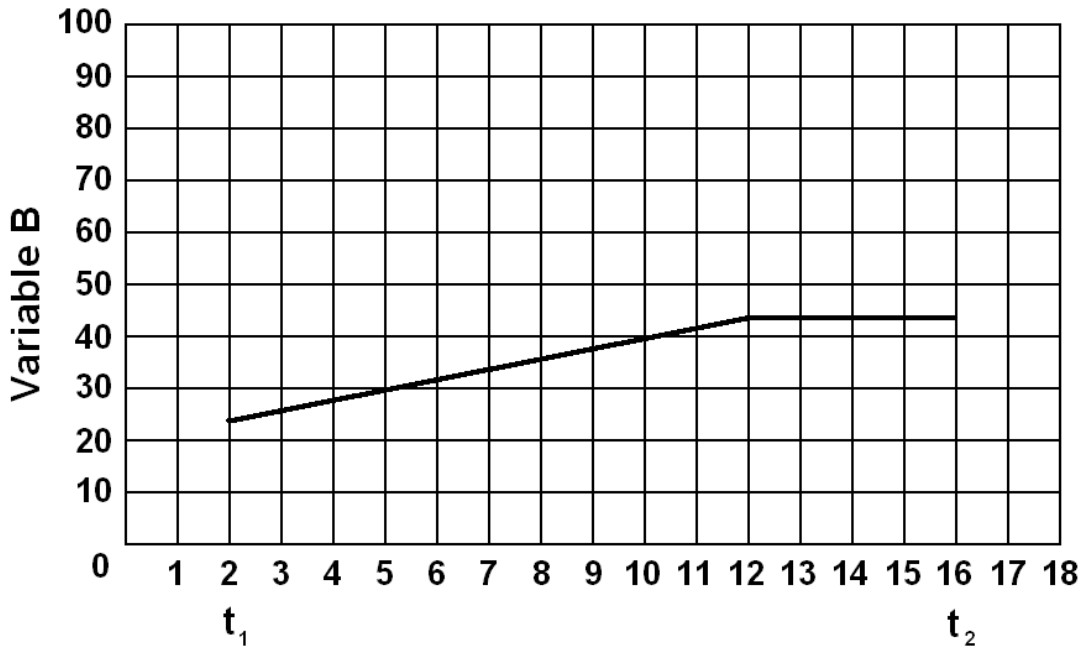


Figure 17: A2 Survivability Fitness

Model 4: Type B Survivability Fitness

Model 4’s focus is on members of a given species avoiding becoming prey. Although realistically both Livability Fitness and Type A Survivability Fitness would affect survival, Model 4 simplifies reality by assuming that only Type B Survivability Fitness has relevance.

Specific Assumptions

- The probability of becoming prey is a function of an individual’s coloration (defined here as degree of darkness).
- That probability varies in a curvilinear manner with degree of coloration (Variable F). A graph describing the relationship would have the following general appearance:

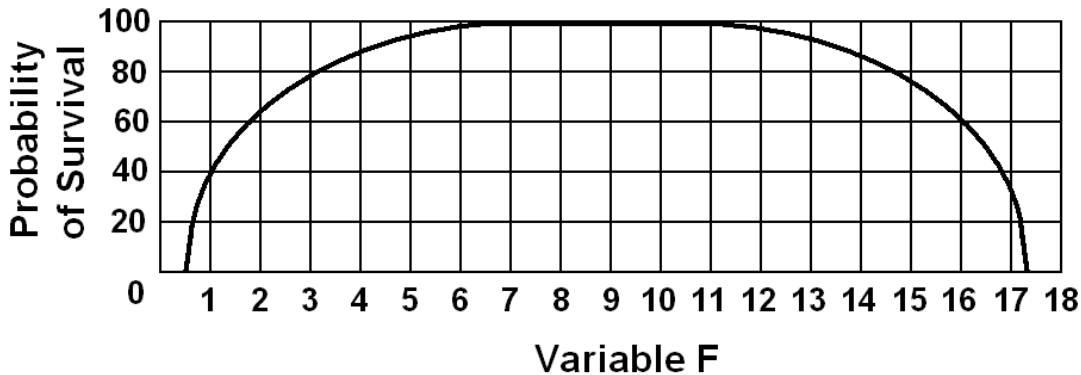


Figure 18: Type B Survivability Fitness

What the graph indicates is that individuals with an F value less than a certain amount—as well as those with more than a certain amount—have zero (0) chance of survival. Beyond the minimum the probability increases until it reaches 100 percent, remains at that level for some distance, then begins to drop until it reaches zero (0) once more. Although the figure has a 100% band narrower than might be realistic, the figure is meant to simply show the general *form* of an expected relationship, not a relationship with empirical support.

With the introduction of individuals of some given species into our hypothetical area there would be variations in fitness—from the unfit (i.e., those with either too little or too much coloration), to those with fitness, but in varying degrees. That is, one could say that the higher the probability of survival associated with a given individual, the greater that individual’s fitness. In this case the largest fitness probability values are associated with the mean of Variable F, and this implies that the mean value of F would tend to remain relatively stable from year to year—so that Figure 15 would describe the (non-) change that would be expected from a temporal standpoint.

Again, the phrase “survival of the fittest” is not a particularly meaningful phrase to use with this model. This model features non-survival of the unfit (those with either a lack of sufficient coloration, or an excess of it), but the “fit” are more difficult to define. Within certain limits coloration confers survivability on individuals, but survivability cannot be thought of here in all-or-nothing terms. Rather, beyond a certain F value the probability of one’s survival increases, but beyond another (larger) F value that probability decreases until it reaches zero (0).

Let us next “complexify” our model by assuming that the species in question is a scavenger species, and we wish to recognize the operation of both Variable C-D (strength and aggressiveness, respectively) *and* Variable F (coloration). Assume further that for the population to be introduced, the correlation between C-D and F is about +0.50. (As I am not placing dots on the graph for Figure 14, you will need to use your imagination.)

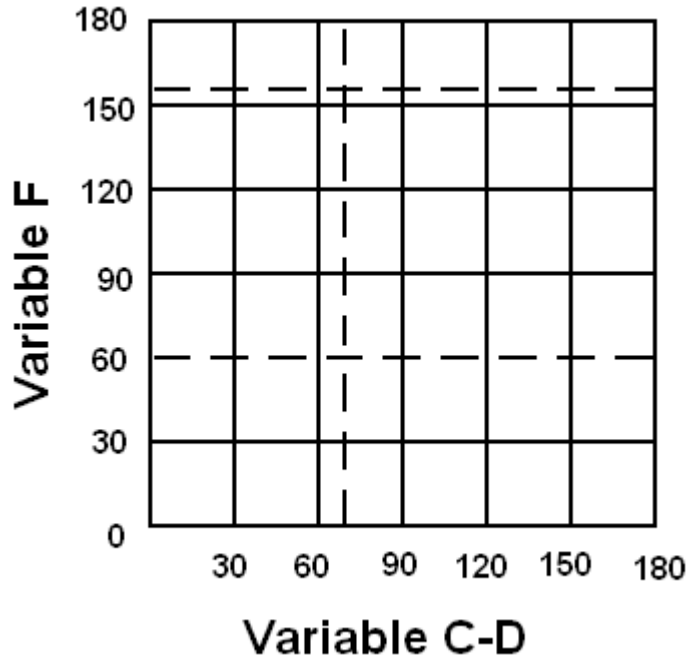


Figure 19: Variable C-D vs. Variable F

The dotted vertical line here (at a value of 70 on the X axis) represents the boundary line for survival for Variable C-D. If dots were placed on the graph representing individuals, those dots to the left of that line would represent individuals lacking Survivability Fitness for Variable C-D, and for that reason alone will not survive long.

The two dotted horizontal lines (one at a value of 60, the other a value of 160) represent the absolute boundary lines for coloration. The individuals below the 60 line lack sufficient coloration, and for that reason would not survive. Some of them might have a sufficiently large value on C-D to survive, but lack sufficient coloration—and therefore be short-lived. Some of the dots might, of course, represent individuals who were doubly damned, in having neither sufficient coloration nor enough speed-aggressiveness to survive.

The individuals above the 160 line would all have sufficient speed-aggressiveness to survive, but have excessive coloration—and therefore have a short life expectancy. Individuals with an F value of about 110 have the highest probability of surviving; in fact, those on either side of 110 have a 100% probability of surviving (as Figure 14 indicates)—assuming, that is, that they have a C-D value greater than 70. And, as an earlier discussion suggests, an individual with a C-D value of 160 would have a greater probability of surviving than one with a value of, say, 80.

Were mean values of F for successive years to be graphed, we would have a graph that looked like Figure 15 (i.e., showing little if any change over time). If mean C-D values were so graphed, the result would be a graph like Figure 17 (i.e., for a time the mean value would increase, but then reach a plateau and remain there).

(Note that although we assumed a correlation of about +0.50 between the two variables before individuals of the species were introduced into the area, once the “unfit” are eliminated it is evident that the degree of correlation has been reduced—perhaps to a value close to zero.)

Model 5: Natural Selection

In the next chapter [Chapter III] the Struggle for Existence amongst all organic beings throughout the world, which inevitably follows from the high geometrical ratio of their increase, will be considered. This is the doctrine of [Rev. Thomas] Malthus [1766 - 1834], applied to the whole animal and vegetable kingdoms. As many more individuals of each species are born than can possibly survive; and as, consequently, there is a frequently recurring struggle for existence, it follows that any being, if it vary however slightly in any manner profitable to itself, under the complex and sometimes varying conditions of life, will have a better chance of surviving, and thus be naturally selected.

. . . of the many individuals which are periodically born, but a small number can survive. I have called this principle, by which each slight variation, if useful, is preserved, by the term Natural Selection, in order to mark its relation to man's power of selection [via breeding]. But the expression often used by Mr. Herbert Spencer of the Survival of the Fittest is more accurate, and is sometimes equally convenient.¹³⁹

We have now arrived at Darwin's “natural selection” model—which has already been given thorough attention in the previous section, and is simply expanded upon here by adding some graphics. Both quotations are from the sixth edition, but the first one has the same wording as the first quotation in the second edition (quoted earlier). The second quotation is also identical to the comparable quotation in the second edition, with the exception of containing the “survival of the fittest” phrase borrowed from Herbert Spencer. These definitions of “natural selection” are as good as one should expect from *Origin* (a rather sad commentary on the book!).

To repeat, however, from earlier sections of this book: In Darwinian thinking there is a certain process (or group of processes) occurring, and the pattern for one year gets repeated the second year, the third year, . . . the n^{th} year. Given this, if for a given time of year one obtains a mean value (or percent (if individuals have been measured using a nominal scale¹⁴⁰)) for each of a

¹³⁹ Charles Darwin, *The Origin of Species by Means of Natural Selection; or, The Preservation of Favored Races in the Struggle for Life and The Descent of Man and Selection in Relation to Sex*. New York: The Modern Library, 1936, pp. 13 and 52. Spencer [1820-1903] had used the phrase “survival of the fittest” in his *Principles of Biology*, a 2-volume work published in 1864, then 1867. Darwin [1809 - 1882] first used the phrase in the fifth edition of *Origin*, published in 1869 pp.361, and 415. The quotations above are from the sixth edition.

¹⁴⁰ For our models we are assuming that all variables can be measured on a continuous scale. In actuality, however, there may very well be variables of relevance that would be measured on a nominal scale (giving rise to percent values) or on the absolute scale of counting numbers (which can be “handled” as if the scale involved were a continuous one).

succession of years, and then plots these mean (or percent) values on a graph, one will find that they “line up” (see Figure 20 below)—and do so because of the assumptions regarding heredity used herein (*not* the Darwinian “blending” theory¹⁴¹). Each year there has been “natural selection” (this occurring during the birthing season—a period that Darwin never mentioned, but one that one must identify to make his model “work”); this occurs each year because it is “natural” for there to be “excess” births with any given species; and because it occurs year after year, the species in question changes in genetic characteristics—and will continue to change indefinitely in a slow, steady, progressive manner.

Darwin saw intra-specific competition as an inevitability, given his assumptions. It is true that in *Origin* Darwin referred, e.g., to (p. 53) a plant on the edge of a desert struggling for life against the drought. But although struggle against the environment was something that Prince Petr Kropotkin [1842-1921] emphasized around the turn of the twentieth century,¹⁴² for Darwin the “struggle for existence” usually meant a struggle with conspecifics. Darwin claimed (also on p. 53) that he was using “struggle for existence” in “a large and metaphorical sense including dependence of one being on another, and including (which is more important) not only the life of the individual, but success in leaving progeny.” In fact, however, the central meaning Darwin gave to (in *Origin*) “natural selection” and “struggle for existence” were as I specify here.

¹⁴¹ In 1867 Henry Charles Fleeming Jenkin [1835-1885], an engineering professor at Edinburgh University (and close friend of, William Thomson, Lord Kelvin), pointed out, in a lengthy review of *Origin*, that under Darwin’s assumption of blending inheritance, natural selection probably cannot modify the “mean species type”—as Darwin evidently thought it would. (Jean Gayon, *Darwinism’s Struggle for Survival: Heredity and the Hypothesis of Natural Selection*. Cambridge, UK: Cambridge University Press, 1998. See Chapter 3, “Jenkin’s Objections, Darwin’s Dilemma,” pp. 85-102.) That is, Jenkin pointed out that the blending theory is incompatible with what Darwin thought natural selection would produce (i.e., slow, steady, progressive change). Jenkin asserted that “the rate of variation in a given direction is not constant, is not erratic; it is a constantly diminishing rate, tending therefore to a limit.” (Quotation from Jenkin’s review of *Origin*, which appeared in *The North British Review*, June 1867, Vol. 46, pp. 277 - 318. I have quoted from the electronic text of the article, prepared by Ian Johnston: <http://www.scholars.nus.edu.sg/landow/victorian/books/victorian.html>. For an excellent discussion of this topic see Section 7 (“Heredity”) of John Wilkins’s “Darwin’s Precursors and Influences,” available on the www.talkorigins.org web site.

¹⁴² Petr Kropotkin, *Mutual Aid, A Factor of Evolution*. Boston: Extending Horizons Books, 1955. First published as a series of articles between 1890-96, then as a book in 1902. The articles (which appeared in the periodical *The Nineteenth Century*) were written in response to Thomas H. Huxley’s “The Struggle for Existence in Human Society,” which appeared in *The Nineteenth Century* in the February 1888 issue, and appears in this 1955 edition as Appendix B (pp. 329-41).

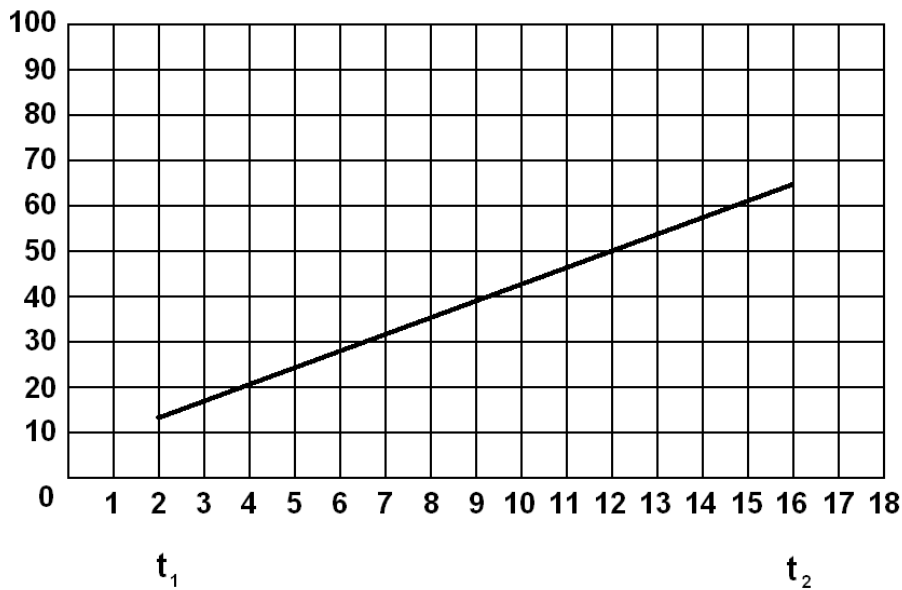


Figure 20: “Progressive” Change

Note a basic logical problem here¹ though.: What is assumed for Species X does not apply for Species Y (the grass eaten by members of Species X)!! One can, indeed, infer (I believe) from the above discussion that Species Y would remain the same over time. Given this, the Darwinian model of natural selection should not be thought of as a general theory! And the fact that it virtually ignores the environment within which Species X and Y exist—in effect assuming that an environment is there (for it provides food), but also not there (for it ignores, e.g., Livability Fitness)—makes it a curious theory indeed!

Given, though, that it is not my intent here to present a full critique Darwin’s theory of natural selection in this chapter—my intent being, rather, to present Darwin’s natural selection model as one among several—let us continue by presenting the next model, Model 21.

Before doing so, however, let us note the particular meaning attached to “fittest” in this model. “Fittest” here does not involve Livability Fitness, nor does it involve Type B Survivability Fitness. It *does* involve Type A Survivability Fitness—but without finding it necessary to distinguish between predators and scavengers. The emphasis in acquiring food is, however, based on traits other than the ones that I used in Models 2 and 3, for the focus is on intra-specific competition, this assumed to be induced by excess births. The “fittest,” then, in this Darwinian natural selection model are those with whatever trait(s) confers an advantage in competition with conspecifics (this competition tacitly being limited to the just-born). One might therefore state that Darwin’s natural selection model focuses not on individuals fitting the physical environment (and therefore surviving) but, rather, on individuals fitting a “*sociological*” environment (and therefore surviving). Not, note, a sociological and physical environment, but *just* a sociological environment.



Figure 21: The Darwinian Model

To complete our discussion of Darwinian natural selection with a focus on graphics, I offer Figure 21 above. This shows the starting point as being excess births, which leads to intra-specific competition, which leads to survival of the fittest and premature deaths on the part of the others, the result being slow, steady, progressive change in one or more variables, that is, natural selection.

Model 6: Accidents

“Accidents,” as the very name implies, occur on a random basis. That is, they are not selective as to when they occur, etc.. Insofar as they occur with the old, they have no impact on the genetic character of the population, because the old have already produced progeny (*if* they have). And insofar as they occur to others, the fact that they occur randomly means that they have no genetic impact in the sense that their occurrence does not affect how a species changes genetically over time—which means that if we take the assumptions of, e.g., Model 1 and add the assumption that accidents occur from time to time, Figure 15 would describe how change occurs over time (in this case there being non-change). With the occurrence of accidents (those resulting in death, that is) there would be a slight dip in the population size of the group in question, but this would be temporary, and would have no impact on how the species changes over time.

Model 7: Disease

Some individuals of a given species may be more susceptible to disease than other members, and die prematurely as a result (perhaps directly by being killed by a predator—as the movie [Never Cry Wolf](#) suggests). However, if a disease is transmissible, even healthy (and otherwise “fit”) individuals can become diseased and die.

If disease strikes a population, it can kill many individuals; but if it kills randomly, it merely reduces the size of the population temporarily, and has no impact on how the species changes genetically over time. If, however, a disease “targets” a certain segment of the population—if, that is, it is *selective*—its impact will be to not only reduce the population size temporarily, but to make the population more “robust.” However, that increased robustness will not necessarily continue over time, so that a pattern of oscillation may occur, so far as robustness is concerned, as successive waves of disease strike a given population. That is, a pattern may emerge like that depicted in Figure 22 below:

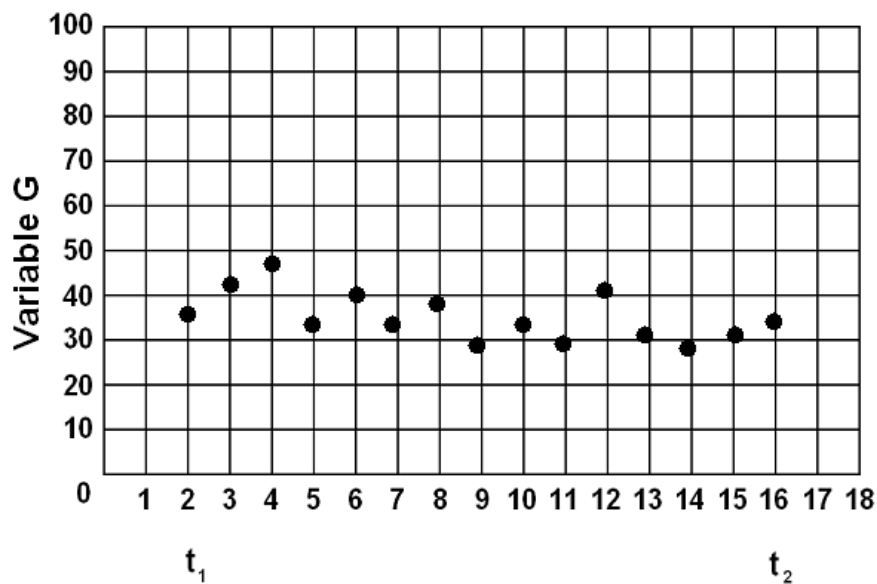


Figure 22: Disease and Species Change

Here Variable G represents robustness, and the graph shows fluctuations from year to year as robustness increases immediately after a period when many are killed by a disease, but robustness declines during a period of normality. The overall trend, however, is for constancy in mean robustness over time (i.e., non-change rather similar to that depicted on Figure 10).

Model 8: Natural Disasters

Up until the past few years we have expected that natural disasters would occur sporadically—so that, e.g., the phrase “100-year flood” meant precisely that. As “global warming” has been occurring, however, not only has the global temperature mean been increasing, but various other

changes have been occurring: Hurricanes have become more numerous and more severe; some areas have been subjected to torrential rains, and consequent flooding; some areas have been inflicted with high temperatures and drought (providing ideal conditions for fires); etc. In addition, we can anticipate that pest problems will increase (which may lead to disease problems), that a rising sea level will not only force people (and others life-forms) to move, but precipitate violence—and that many other changes will occur that we can't even anticipate. Changes which are likely to have negative impacts (principally, at any rate).

When natural disasters occur, they may or may not be selective so far as the genetic composition of a group occurs—but the latter is more likely. Thus, if they are not selective, they will cause “dips” in population size for a given species, but this would be temporary, and not impact the genetic character of the population—so that Figure 10 would describe population (non-) change over time.

Noel T. Boaz has referred to a 1898 study of English sparrows by ornithologist Herman Bumpus which “discovered that the birds that survived were nearest the mean in terms of wing length and body size.”¹⁴³ What this study illustrates is the fact that certain types of natural disasters may be selective for certain species. If those selected for non-survival occupy the “tails” of the frequency distribution (see Figure 16) for some relevant trait, the type of natural disaster in question will not impact the population, so far as genetic change over time is concerned. If, however, the selection involves removal of either those in the right-most tail or the left-most one, the population may experience short-term change (up or down, as the case may be) in genetic character.

Model 9: Sexual Selection (Female Choice)

The models presented to this point have focused solely on survival and non-survival, posited various mechanisms relative to survival/non-survival, and developed the implications of those mechanisms for survival and non-survival. All of the models have assumed that all individuals of a species are capable of producing progeny (upon reaching maturity), have a desire to do so—and do (all producing the same number of progeny). Models 9 and 10, however, differ substantially from the models discussed heretofore in that they ignore the survival/non-survival matter and focus instead on variations between individuals in production of progeny, focusing specifically on the extreme variation associated with sexual selection.

Two types of sexual selection are identified. The two are similar in that they feature one or a few males mating with a number of females. The difference is that with the first model (“female choice”) a number of females jointly choose a single (or few) males with which to mate, leaving most of the males producing no progeny. The second model (“male choice”) is more harem-like in appearance in that a dominant male, who likely arose to dominance via a process of competition with other males, forcibly excludes other males from an opportunity for engaging in mating behavior—so that again most of the males produce no progeny. Which type is more common? It has long been thought (by male researchers!) that the latter was more common, but as Mariette Nowak has pointed out, “It is almost always the female who has the choice, at least

¹⁴³ *Evolving Health*, p. 9.

the prime choice, when it comes to mating.” She goes on to note that Irven DeVore has stated that “Males are a vast breeding experiment run by females.”¹⁴⁴ (!)

With the first (Model 9), it is assumed that all of the females in a given group select but one of the males in the group with which to mate. With the second (Model 10), the superficial appearance of the group is the same as with Model 9, but in this case it is a matter of male choice: Only one male mates with females (as with Model 9), but in this case it is a male who chooses (for which reason this might be termed the “harem” model, in which a dominant male emerges).

For Model 9, then, let us assume that the females of the group evaluate the males on the basis of Variable H, and select, for mating purposes, the male that they perceive as having the most H. This variable might be one that has relevance for, e.g., Survivability Fitness; on the other hand, however, it might very well be a variable different from any that have played a role in the models so far discussed (such as “beauty”). Depending on what Variable H is, the mating behavior of the females might contribute to the survivability of the species in question, might do the opposite, or might have no impact on the survivability of the species. With Model 9 it is of course the case that the phrase “survival of the fittest” has little if any meaning given that it is unknown how the mating behavior of the females will impact the species—except to cause an increase over time in the mean value of H, but only to a point (so that Figure 17 would be relevant).

Of considerable interest here is the fact that Nancy Makepeace Tanner has developed an argument (given more attention in Chapter 12) that gives female choice a prominent role in the development of the human species. She has argued that females of our ancestors would have selected, as mating material, males who had a tendency to share food, who were friendly, but who also were “skilled in defense and protection against predator species by intimidation displays and by throwing objects.”¹⁴⁵ Males, that is, who behaved in an altruistic, cooperative manner relative to conspecifics, but were also capable of defending female conspecifics (and their offspring) from predators, and would do so when necessary.

Males having such characteristics might, on the one hand, have a genetic predisposition for such behavior; we must also, though, allow for the possibility that although, e.g., an attribute such as strength cannot be learned, altruistic, cooperative behavior *can* be. Insofar, as the traits referred to by Tanner have a genetic basis, the implication is that their mating behavior would result in the birth (eventually) of just individuals—both males and females—with a natural tendency to engage in altruistic, cooperative behavior. And even those males having weak such tendencies—but having other traits making them attractive to females—might *choose* to be altruistic and cooperative to enhance their chance of being chosen for mating purposes by the females. After all, [Theodore Reik](#) likely was not far off the mark in stating that women use sex to get love, and men use love to get sex! Insofar as that’s the case, there is no guarantee that the progeny of a

¹⁴⁴ *Eve’s Rib: A Revolutionary New View of Female Sex Roles*. New York: St. Martin’s Press, 1980, pp. 50 and 52.

¹⁴⁵ *On Becoming Human*. New York: ., p. 165.

male who “fakes” cooperative behavior will transmit any proclivity for such behavior to offspring.

In discussing the natural selection model (Model 5) I pointed out that although many seem to think that that model “proves” that individuals are naturally selfish, it does nothing of the sort. It may “explain” *aggressiveness*, but decidedly does not explain *selfishness*; rather, it *assumes* (tacitly) selfishness. A model cannot simultaneously *assume* and *explain* something!

Whereas the natural selection model gives one no basis whatsoever for arguing that humans, e.g., are naturally selfish, Tanner’s argument gives as a plausible basis for arguing, rather, that humans are naturally altruistic and cooperative. What adds force to Tanner’s argument is that (1) experimental research demonstrates that most people prefer to behave in an altruistic and cooperative fashion, (2) inter-societal variations in the strength of those tendencies can only be explained on the basis of cultural factors (not biology—obviously, given that all humans are members of the same species), (3) research on our nearest biological “cousins” indicates that such traits are common with them, and therefore would be expected with our species, and (4) anthropological studies of “primitive” (i.e., gatherer-hunter) societies (along with archeological research) suggests that prior to the Agricultural Revolution millennia ago, altruistic/cooperative behavior was the norm.

For a number of reasons, then, we should accept as fact the thesis that humans are naturally altruistic and cooperative, and that the reason such behaviors are not more common is that the (“civilized”) societies that have emerged since the Agricultural Revolution have developed in such a way as to encourage contrary behavior.

Another important point that I would like to make here is that the fact that the major religions of the world uphold such values as altruism and cooperativeness suggest that “once upon a time” such values *did*, in fact, prevail. Louis Wallis has stated: “The Deuteronomic center of gravity goes back to the psychology of the wilderness from which the clans of early Israel emerged. The nomad clansmen share everything.”¹⁴⁶ Research subsequent to the publication of Wallis’s book casts doubt on Wallis’s assumption that the Hebrews had pastoral nomadic roots. But Wallis’s point that if they *did* have such roots, and given that certain behavioral norms are associated with a pastoral nomadic way of life, one would expect that those norms would not be abandoned easily—and especially if they had a genetic basis.

Tanner gives us a theoretical argument in support of the thesis that humans are naturally altruistic and cooperative, and other lines of reasoning can be used to arrive at the same conclusion. It is foolish, then, for us to go on accepting the assertion that humans, rather, are naturally selfish and individualistic. Indeed, our acceptance of those false “truths” may very well underline our current “global warming” problem (among other problems)—and could very well result in the extinction of our species (along with many others, of course). Supposedly, the human species is the most intelligent of all species—but there is good reason to question that assumption!

¹⁴⁶ *The Bible is Human*. New York: AMS Press, an imprint of the 1942 edition published by Columbia University Press, p. 221.

The final point that I would like to make here is that sexual selection—of either type—can work *against* survivability fitness. Consider the following diagram (Figure 23): The species referred to here is the peacock, and the operative selection mechanism is assumed to be female-choice sexual selection. Females are assumed to select males for mating on the basis of the plumage size (a surrogate to beauty) of males, and as a result of this male plumage size becomes larger year after year. The problem with this is that as male plumage size increases, so does their susceptibility to predators. The “dots” on Figure 23 represent a group of peacocks for each of a series of years, with the diameter of the circle being proportional to group size. What the graph shows is that as plumage size increases, the group *decreases* in size because more and more males are taken by predators. Conceivably, this process could continue until the group becomes so small that, in effect, it kills itself off. Presumably, however, at some point the females would perceive that their choice-making was having disastrous consequences, so they would shift to a new choice criterion—and thus save themselves from extinction.

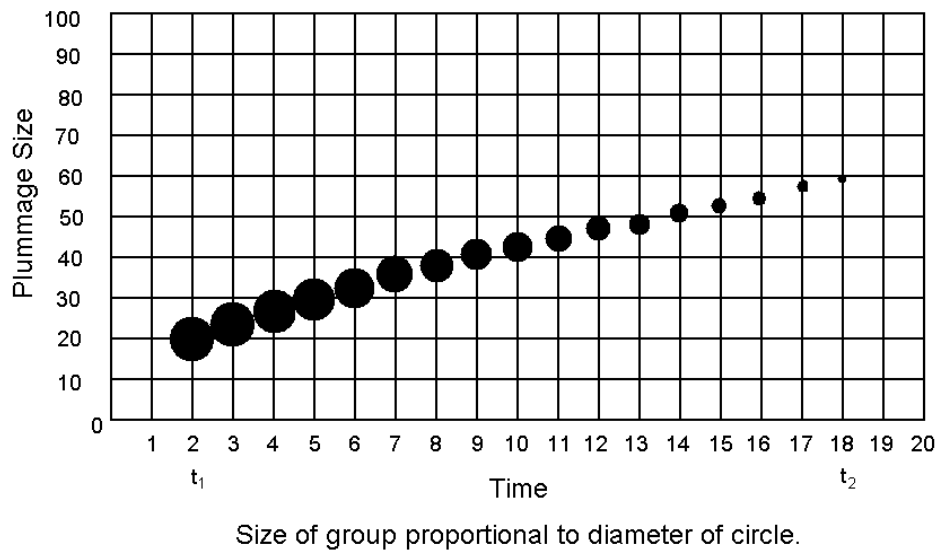


Figure 23: Female Choice Sexual Selection

Model 10: Sexual Selection (Male Choice)

From a superficial standpoint this model appears to be identical to Model 9, but in this case the male who does the selecting is one who has won in competition with other males for the right to mate with the females. This means that whatever the attributes that permitted that individual to win in that competition, if it has a genetic basis, the population will tend to move in that direction. As with Female Choice sexual selection, that direction could be toward increased survivability, the opposite, or neither. Thus, we cannot graph the change, because it’s unknown. And, of course, if change begins in a certain direction, there is no guarantee that it will *remain* in that direction. For just as the females in Model 9 may change their minds over time, and make their choice on the basis of different variables at different times, so might the fact that success by

males in winning over conspecifics, thereby gaining the “right” to mate with the females may change over time.

It would seem that the basic difference between the two models would be that certain variables would always determine the winners in the male choice case (e.g., strength), whereas over time females might shift from one variable to another. After all, it’s a well-known fact that females are fickle and can’t make up their minds! (Just kidding!)

Model 11: Environmental Change (Regular)

Assume the situation of Model 1, where the focus is on Livability Fitness, and Figure 15 shows that Variable A changes but slightly from year to year. That model assumed that the environment itself remained the same year after year, and it was that fact that explained why Variable A remained a virtual constant from year to year. For Model 11, however, let us assume that the environment is changing steadily and by the same amount from year to year.

The species introduced into our hypothetical area might respond to this change by migrating to another area—but we have assumed away that possibility. We have given the species just one option, that of adapting to the changing environment. What might happen is depicted in Figure 24 below:

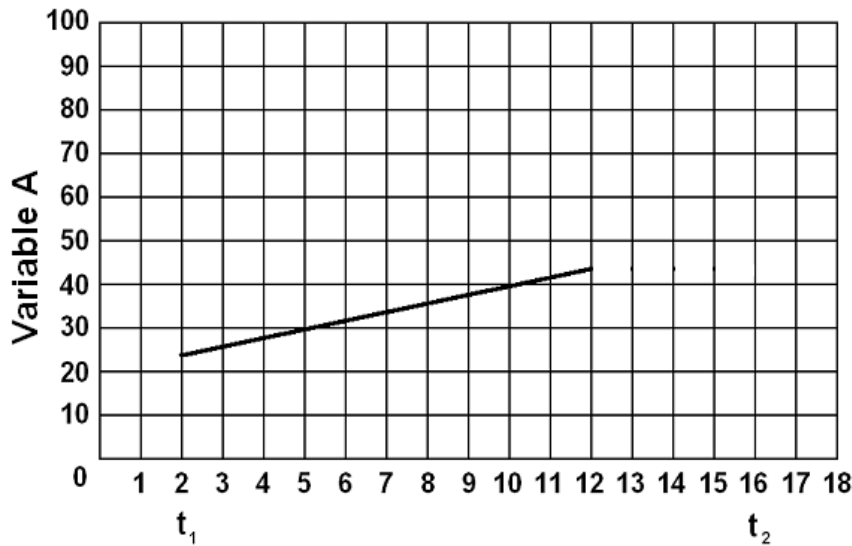


Figure 24: Environmental Change Model

This shows that the mean A value increases over time, but that the line representing the relationship between A and time abruptly stops at year 12. What this means is that the species has reached its adaptability limit, and has become extinct (for the given area, at any rate).

Throughout the period of time of the species’s existence the “fit” have survived (with *all* of the fit surviving, if we assume away other factors). But after a certain point the number of survivors begins to diminish, until no individuals of the species are able to survive, and the species

becomes “extinct.” Model 11 might have applicability for some species, but given that many species have the capability of moving with ease, such species can use the strategy of migration to avoid the fate of extinction.

Model 12: Environmental Change (Irregular)

The environment can change from year to year (especially in temperature and precipitation characteristics), without there being any long-term change in the environment over long periods of time. Such changes can cause changes in a species from year to year, so that if one measures, e.g., beak length of finches from year to year, one may find that there are measurable differences from year to year.¹⁴⁷ Differences that would display a pattern like that depicted in Figure 22.

It may be tempting to argue that empirical evidence of such change from year to year is proof that Darwinian natural selection is occurring. But such a conclusion would be entirely without merit. In the first place, the change involved is change occurring from one year to another, with a long-run pattern of no change! Second, the mechanism involved in bringing about the change is unrelated to the mechanism involved with the natural selection model (Model 5): Model 12’s mechanism is irregular environmental change, Model 5’s is intraspecific competition induced by excess births.

I should perhaps add here that I am not presenting a model that involves catastrophic environmental change, but that does not mean that such change has not been important in real world terms. In fact, it appears that in terms of geologic time there have been a few period of really significant geologic activity, and that biological developments have been associated with those periods. On the one hand, many extinctions have occurred during those periods. But on the other hand, many new species have come into existence during those periods, these having presumably emerged from pre-existing species.¹⁴⁸ Do such periods give birth to new species because the geological activity somehow causes more mutations to occur than under “normal” conditions? Does the geological upheaval precipitate behavioral changes, with consequent changes in how selection mechanisms work?

I have no answers to these questions (and am not aware of any answers provided by anyone else), but what’s particularly significant about the geologic pattern of evolution is that it suggests that it’s polytypic evolution (rather than monotypic evolution) that dominates the evolution story. Which means, in turn, that the Darwinian model of natural selection (Model 5) has little, if any, relevance for explaining evolution as it has occurred in the real world (from the standpoint of geologic time)! Just how significant a role natural selection (defined properly!) plays, and has played, with real-world species is a question that I will leave to the biologists.

A fact of note regarding the 12 models presented above is that (a) only Model 5 (the natural selection one) explicitly assumes excess births and (b) features premature deaths occurring as a

¹⁴⁷ See, e.g., Jonathan Weiner, *The Beak of the Finch*. New York: Alfred A. Knopf, 1994.

¹⁴⁸ The generalization was stated by Eldredge in a 1971 article in the journal *Evolution*. For a discussion of the generalization see his *The Pattern of Evolution*. New York: W. H. Freeman and Company, 1999, pp. 16 - 23, 140 - 45, and 157 - 58.

result, and only a result, of intra-specific competition, *that* precipitated by the excess births. Does this mean that excess births need not occur in the real world? The answer is a resounding “No”—which means that the natural selection model has a positive feature lacking in all of the other models. The reason the excess births assumption is a positive feature of a model is that members of any given species need to eat to live, and this involves either engaging in predation or in scavenging; i.e., it involves eating individuals (or parts of same) of other species (ignoring the possibility of cannibalism). If there is to be relative stability in population size of the various species occupying a given area, there *must* be the production of excess births with many of those species. One cannot expect that only those whose age is beyond the time when they have produced progeny to be “taken” by predators, thereby providing the food necessary to keep the relevant predators alive. Such taking would, of course, have no impact on the genetic character of the prey species, but such taking could not provide more than some of the food necessary to sustain the relevant predators. Many of the just-born must be taken; and insofar as the deformed, sick, lame, etc. are taken, the all-around health of the prey species benefits.

Although Darwin was correct in assuming that the production of excess births was a virtual law of nature, he erred in assuming that the inevitable *result* was intra-specific competition. For some reason he failed to recognize that any living thing must eat to live, and *that* involves eating live things. And it is *this* fact that members of one species eat members of other species that (in conjunction with different birth rates with different species) accounts for the fact that a certain balance is maintained in nature in numbers within different species. In fact, Darwin unwittingly introduced a paradox with his theory: The species that is central to his model is (let us assume) a predator, whose population is kept in check by intra-specific competition, whereas the species whose members are eaten by this species are kept in check by predation! Meaning that the former species experiences slow, steady, progressive change in the “success” variable (and other variables correlated with it), while the other species, there not being competition associated with it/them, do not experience change over time. Rather, they remain at a robust level, relatively disease-free, with the absence of a burden of the old, lame, etc. within the group.