Darwin's Theory of Natural Selection and Its Moral Purpose

Robert J. Richards

Thomas Henry Huxley recalled that after he had read Darwin's *Origin of Species*, he had exclaimed to himself: "How extremely stupid not to have thought of that!" (Huxley,1900, 1: 183). It is a famous but puzzling remark. In his contribution to Francis Darwin's *Life and Letters of Charles Darwin*, Huxley rehearsed the history of his engagement with the idea of transmutation of species. He mentioned the views of Robert Grant, an advocate of Lamarck, and Robert Chambers, who anonymously published *Vestiges of the Natural History of Creation* (1844), which advanced a crude idea of transmutation. He also recounted his rejection of Agassiz's belief that species were progressively replaced by the divine hand. He neglected altogether his friend Herbert Spencer's early Lamarckian ideas about species development, which were also part of the long history of his encounters with the theory of descent. None of these sources moved him to adopt any version of the transmutation hypothesis.

Huxley was clear about what finally led him to abandon his long-standing belief in species stability:

> The facts of variability, of the struggle for existence, of adaptation to conditions, were notorious enough; but none of us had suspected that the road to the heart of the species problem lay through them, until Darwin and Wallace dispelled the darkness, and the beacon-fire of the “Origin” guided the benighted (Huxley, 1900, 1: 179-83).

The elements that Huxley indicated—variability, struggle for existence, adaptation—form core features of Darwin’s conception of natural selection. Thus what Huxley admonished himself for not immediately comprehending was not the fact, as it might be called, of species change but the cause of that change. Huxley’s exclamation suggests—and it has usually been interpreted to affirm—that the idea of natural selection was really quite simple and that when the few elements composing it were held before the mind’s eye, the principle and its significance would flash out. The elements, it is supposed, fall together in this way: species members vary in their heritable traits from each other; more individuals are produced than the resources of the environment can sustain; those that by chance have traits that better fit them than others of their kind to circumstances will more likely survive to pass on those traits to offspring; consequently, the structural character of the species will continue to alter over generations until individuals appear specifically different from their ancestors.

Yet, if the idea of natural selection were as simple and fundamental as Huxley suggested and as countless scholars have maintained, why did it take so long for the theory to be published after Darwin supposedly discovered it? And why did it then require a very long book to make its truth obvious? In this essay, I will try to answer

these questions. I will do so by showing that the principle of natural selection is not simple but complex and that it only gradually took shape in Darwin's mind. In what follows, I will refer to the "principle" or "device" of natural selection, never the "mechanism" of selection. Though the phrase "mechanism of natural selection" comes trippingly to our lips, it never came to Darwin's in the *Origin*; and I will explain why. I will also use the term "evolution" to describe the idea of species descent with modification. Somehow the notion has gained currency that Darwin avoided the term because it suggested progressive development. This assumption has no warrant for two reasons. First, the term is obviously present, in its participial form, as the very last word in the *Origin*, as well as being freely used as a noun in the last edition of the *Origin* (1872), in the *Variation of Animals and Plants under Domestication* (1868), and throughout the *Descent of Man* (1871) and *The Expression of the Emotions in Man and Animals* (1872). But the second reason for rejecting the assumption is that Darwin's theory is, indeed, progressivist; and his device of natural selection was designed to produce evolutionary progress.

Darwin's Early Efforts to Explain Transformation

Shortly after he returned from his voyage on *H.M.S. Beagle* (1831-1836), Darwin began seriously to entertain the hypothesis of species change over time. He had been introduced to the idea through reading his grandfather Erasmus Darwin's *Zoonomia* 1794-1796), which included speculations about species development; and, while at Edinburgh medical school (1825-1827), he studied Lamarck's *Système des animaux*

sans vertèbres (1801) under the tutelage of Robert Grant, a convinced evolutionist. On the voyage, he carried Lamarck's *Histoire naturelle des animaux san vertèbres* (1815-1822), in which the idea of evolutionary change was prominent. He got another large dose of the Frenchman's ideas during his time off the coast of South America, where he received by merchant ship the second volume of Charles Lyell's *Principles of Geology* (1831-1833), which contained a searching discussion and negative critique of the fanciful supposition of an "evolution of one species out of another" (Lyell, 1987, 2: 60). Undoubtedly the rejection of Lamarck by Lyell and most British naturalists gave Darwin pause; but after his return to England, while sorting and cataloguing his specimens from the Galapagos, he came to understand that his materials supplied compelling evidence for the suspect theory.

In his various early notebooks (January 1837 to June 1838), Darwin began to work out different possibilities to explain species change (Richards, 1987, 85-98). Initially, he supposed that a species might be "created for a definite time," so that when its span of years was exhausted, it went extinct and another, affiliated species took its place (*Notebooks*, 12, 62). He rather quickly abandoned the idea of species senescence, and began to think in terms of Lamarck's notion of the direct effects of the environment, especially the possible impact of the imponderable fluids of heat and electricity (*Notebooks*, 175). If the device of environmental impact were to meet what seemed to be the empirical requirement—as evidenced by the pattern of fossil deposits, going from simple shells at the deepest levels to complex vertebrate remains at higher levels—then it had to produce progressive development. If species resembled ideas, then progressive change would seem to be a natural result, or so Darwin speculated:

“Each species changes. Does it progress. Man gains ideas. The simplest cannot help.—becoming more complicated; & if we look to first origin there must be progress” (*Notebooks*, 175). Being the conservative thinker that he was, Darwin retained in the *Origin* the idea that some species, under special conditions, might alter through direct environmental impact as well as the conviction that modifications would be progressive.

Darwin seems to have soon recognized that the direct influence of surroundings on an organism could not account for its more complex adaptations, and so he began constructing another causal device. He had been stimulated by an essay of Frédéric Cuvier, which suggested that animals might acquire heritable traits through exercise in response to particular circumstances. He rather quickly concluded that “all structures either direct effect of habit, or hereditary <& combined> effect of habit” (*Notebooks*, 259).[1] Darwin, thus, assumed that new habits, if practiced by the population over long periods of time, would turn into instincts; and these latter would eventually modify anatomical structures, thus altering the species. Use-inheritance was, of course, a principal mode of species transformation for Lamarck.

In developing his own theory of use-inheritance, Darwin carefully distinguished his ideas from those of his discredited predecessor—or at least he convinced himself that their ideas were quite different. He attempted to distance himself from the French naturalist by proposing that habits introduced into a population would first gradually become instinctual before they altered anatomy. And instincts—innate patterns of behavior—would be expressed automatically, without the intervention of conscious will-power, the presumptive Lamarckian mode (*Notebooks*, 292). By early summer of 1838,

Darwin thus had two devices by which to explain descent of species with modification: the direct effects of the environment and his habit-instinct device.

Elements of the Theory of Natural Selection

At the end of September 1838, Darwin paged through Thomas Malthus's *Essay on the Principle of Population*. As he later recalled in his *Autobiography*, this happy event changed everything for his developing conceptions:

> I soon perceived that selection was the keystone of man's success in making useful races of animals and plants. But how selection could be applied to organisms living in a state of nature remained for some time a mystery to me.
>
> In October 1838, that is, fifteen months after I had begun my systematic enquiry, I happened to read for amusement Malthus on *Population*, and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The result of this would be the formation of new species. Here, then, I had at last got a theory by which to work (Autobiography, 119-20).

Darwin's description provides the classic account of his discovery, and it does capture a moment of that discovery, though not the complete character or full scope of his mature conception. The account in the *Autobiography* needs to be placed against the notebooks, essays, and various editions of the *Origin* and the *Descent of Man.* These comparisons will reveal many moments of discovery, and a gradual development of his theory of natural selection from 1838 through the next four decades.

In the *Autobiography,* Darwin mentioned two considerations that had readied him to detect in Malthus a new possibility for the explanation of species development: the power of artificial selection and the role of struggle. Lamarck had suggested domestic breeding as the model for what occurred in nature. Undeterred by Lyell's objection that domestic animals and plants were specially created for man (Lyell, 1830-33, 2: 41), Darwin began reading in breeders' manuals, such as those by John Sebright (1809) and John Wilkinson (1820). This literature brought him to understand the power of domestic "selection" (Sebright's term) but he was initially puzzled, as his *Autobiography* suggests, about what might play the role of the natural selector or "picker." In mid summer of 1838, he observed:

> The Varieties of the domesticated animals must be most complicated, because they are partly local & then the local ones are taken to fresh country & breed confined, to certain best individuals.—scarcely any breed but what some individuals are picked out.—in a really natural breed, not one is picked out . . . (Notebooks, 337).

In this passage, he appears to have been wondering how selecting could occur in nature when no agent was picking the few “best individuals” to breed.

In the *Autobiography,* Darwin indicated that the second idea that prepared the way to divine the significance of Malthus’s *Essay* was that of the struggle for existence. Lyell, in the *Principles of Geology*, had mentioned de Candolle’s observation that all the plants of a country “are at war with one another” (Lyell, 1830-33, 2: 131). This kind of struggle, Lyell believed, would be the cause of “mortality” of species, of which fossils gave abundant evidence (Lyell, 1830-33, 2: 130). In his own reading of Lyell, Darwin took to heart the implied admonition to “study the wars of organic being” (*Notebooks*, 262).

These antecedent notions gleaned from Lamarck, Lyell, and the breeders led Darwin to the brink of a stable conception that would begin to take more explicit form after reading Malthus’s *Essay* in late September 1838. In spring of 1837, for instance, he considered how a multitude of varieties might yield creatures better adapted to circumstances: “whether every animal produces in course of ages ten thousand varieties, (influenced itself perhaps by circumstances) & those alone preserved which are well adapted” (*Notebooks*, 193). Here Darwin mentioned in passing a central element of his principle of natural selection without, apparently, detecting its significance. And a year later something like both natural and sexual selection spilled on to the pages of his *Notebook C*: “Whether species may not be made by a little more vigour being given to the chance offspring who have any slight peculiarity of structure. <<hence seals take victorious seals, hence deer victorious deer, hence males armed &

pugnacious all orders; cocks all war-like)>>" (*Notebooks*, 258; likely a gloss on Sebright, 1809, 15-16). It is fair to say, nonetheless, that the foundations for Darwin's device of natural selection were laid on the ground of Malthus's *Essay.* His reading of that book caused those earlier presentiments to settle into a firm platform for further development.

The Malthus Episode

Malthus had composed his book to investigate two questions: What has kept humankind from steadily advancing in happiness? Can the impediments to happiness be removed? Famously, he argued that the chief barrier to the progress of civil society was that population increase would always outstrip the growth in the food supply, thus causing periodic misery and famine. What caught Darwin's eye in the opening sections of Malthus's *Essay*, as suggested by scorings in his copy of the book, was the notion of population pressure through geometric increase:

> In the northern states of America, where the means of subsistence have been more ample . . . the population has been found to double itself, for above a century and half successively, in less than twenty-five years. . . It may safely be pronounced, therefore, that population, when unchecked, goes on doubling itself every twenty-five years, or increases in a geometrical ratio. . . But the food to support the increase from the greater number will by no means be obtained with the same facility. Man is necessarily confined in room (Malthus, 1826, 5-7).

Darwin found in those passages from Malthus a propulsive force that had two effects: it would cause the death of the vast number in the population by reason of the better adapted pushing out the weaker, and thus it would sort out, or transform, the population. On September 28, 1838, Darwin phrased it this way in his *Notebook D*:

> Even the energetic language of <Malthus> <<Decandoelle>> does not convey the warring of the species as inference from Malthus. . . population in increase at geometrical ratio in FAR SHORTER time than 25 years—yet until the one sentence of Malthus no one clearly perceived the great check amongst men. . . One may say there is a force like a hundred thousand wedges trying force <into> every kind of adapted structure into the gaps <of> in the oeconomy of Nature, or rather forming gaps by thrusting out weaker ones. <<The final cause of all this wedging, must be to sort out proper structure & adapt it to change (*Notebooks*, 375-76).

All the "wedging" caused by population pressure would have the effect, according to Darwin, of filtering out all but the most fit organisms and thus adapting them (actually, leaving them pre-adapted) to their circumstances.

Though natural selection is the linchpin of Darwin's theory of evolution, his notebooks indicate only the slow emergence of its ramifying features. He reflected on his burgeoning notions through the first week of October 1838, but then turned to other matters. Through the next few months, here and there, the implications became more prominent in his thought. In early December, for instance, he explicitly drew for the first time the analogy between natural selection and domestic selection: "It is a beautiful

part of my theory, that <<domesticated>> races . . . are made by percisely [sic] same means as species" (*Notebooks*, 416). But the most interesting reflections, which belie the standard assumptions about Darwin's theory, were directed to the final cause or purpose of evolution. This teleological framework would help organize several other elements constituting his developing notion.

The Purpose of Progressive Evolution: *Human Beings and Morality*

The great peroration at the very end of the *Origin of Species* asserts a long-standing and permanent conviction of Darwin, namely that the "object," or purpose, of the "war of nature" is "the production of the higher animals" (*Origin*, 490). And the unspoken, but clearly intended, higher animals are human beings with their moral sentiments. Darwin imbedded his developing theory of natural selection in a decidedly progessivist and teleological framework, a framework quite obvious when one examines the initial construction of his theory.

At the end of October 1838, he focused on the newly formulated device:

> My theory gives great final cause <<I do not wish to say only cause, but one great final cause . . .>> of sexes. . . for otherwise there would be as many species, as individuals, &. . . few only social . . . hence not social instincts, which as I hope to show is <<probably>> the foundation of all that is most beautiful in the moral sentiments of the animated beings (*Notebooks*, 409).

In this intricate cascade of ideas, Darwin traced a path from sexual generation to its consequences: the establishment of stable species, then the appearance of social species, and finally the ultimate purpose of the process, the production of human beings with their moral sentiments. This trajectory needs further explication.

When Darwin opened his first transmutation notebook in spring 1837, he began with his grandfather's reflections on the special value of sexual generation over a-sexual kinds of reproduction. The grandson supposed that sexually produced offspring would, during gestation, recapitulate the forms of ancestor species. As he initially put the principle of recapitulation: "The ordinary kind [i.e., sexual reproduction], which is a longer process, the new individual passing through several stages (typical, <of the> or shortened repetition of what the original molecule has done)" (*Notebooks*, 170). Darwin retained the principle of embryological recapitulation right through the several editions of the *Origin* (Nyhart, this volume). Recapitulation produced an individual that gathered in itself all the progressive adaptations of its ancestors. But the key to progressive adaptation was the variability that came with sexual reproduction (*Notebooks*, 171). In spring of 1837, he still did not understand exactly how variability might function in adaptation; he yet perceived that variable offspring could adjust to a changing environment in ways that clonally reproducing plants and animals could not. Moreover, in variable offspring accidental injuries would not accumulate as they would in continuously reproducing a-sexual organisms. Hence stable species would result from sexual generation. For "without sexual crossing, there would be endless changes . . . & hence there could not be *improvement* . <<& hence not <<be>> higher animals"

(*Notebooks*, 410). But once stable species obtained, social behavior and ultimately moral behavior might ensue.

Just at the time Darwin considered the "great final cause" of sexual generation—namely the production of higher animals with their moral traits—he opened his *Notebook N*, in which he began to compose an account of the moral sentiments. He worked out the kernel of his conception, which would later flower in the *Descent of Man*, in a fanciful example. He imagined the case of a dog with incipient moral instincts:

> Dog obeying instincts of running hare is stopped by fleas, also by greater temptation as bitch . . . Now if dogs mind were so framed that he constantly compared his impressions, & wished he had done so & so for his interest, & found he disobeyed a wish which was part of his system, & constant, for a wish which was only short & might otherwise have been relieved, he would be sorry or have troubled conscience—therefore I say grant reason to any animal with social & sexual instincts <<& yet with passions he *must* have conscience—this is capital view.—Dogs conscience would not have been same with mans because original instinct different (*Notebooks*, 563-64).

Darwin believed that the moral instincts were essentially persistent social instincts that might continue to urge cooperative action even after being interrupted by a more powerful, self-directed impulse. As he suggested to himself at this time: "May not moral sense arise from our enlarged capacity <acting> <<yet being obscurely guided>> or strong instinctive sexual, parental & social instincts give rise 'do unto others as yourself',

‘love thy neighbour as thyself’. Analyse this out” (*Notebooks*, 558). He would, indeed, continue to analyze out his theory; for at this point in its development, he did not see how other- directed, social instincts, which gave no benefit to their carrier, could be produced by selection. This difficulty seems to have led him to retain the device of inherited habit to explain the origin of the social instincts. Thus in late spring 1839, he formulated what he called the “law of utility”—derived from Paley—which supposed that social utility would lead the whole species to adopt certain habits that, through dint of exercise, would become instinctive: “*On Law of* Utility Nothing but that which has beneficial tendency through many ages would be acquired [i.e., necessary social habits]. . . It is probable that becomes instinctive which is repeated under many generations” (*Notebooks*, 623). While Darwin never gave up the idea that habits could become inherited, he would solve the problem of the natural selection of social instincts only in the final throes of composing the *Origin*.

At the very end of October 1838, Darwin gave an analytic summary of his developing idea, a neat set of virtually axiomatic principles constituting his device:

> Three principles, will account for all
>
> (1) Grandchildren. like grandfathers
>
> (2) Tendency to small change. . .
>
> (3) Great fertility in proportion to support of parents (*Notebooks*, 412-13).

These factors may be interpreted as: traits of organisms are heritable (with occasional reversions); these traits vary slightly from generation to generation; and reproduction outstrips food resources (the Malthusian factor). These principles seem very much like

those “necessary and sufficient” axioms advanced by contemporary evolutionary theorists: variation, heritability, and differential survival (Lewontin, 1978). Such analytic reduction does appear to render evolution by natural selection a quite simple concept, as Huxley supposed. However, these bare principles do not identify a causal force that might scrutinize the traits of organisms to pick out just those that could provide an advantage and thus be preserved. Darwin would shortly construct that force as both a moral and an intelligent agent, and the structure of that conception would sink deeply into the language of the *Origin*.

Natural Selection as an Intelligent and Moral Force

In 1842, Darwin roughly sketched out the outlines of his theory, and two years later he enlarged the essay to compose a more complete and systematic version. In the first section of both essays, as in the first chapter of the *Origin,* Darwin discussed artificial selection. He suggested that variations in traits of plants and animals occurred as the result of the effects of the environment in two different ways: directly on features of the malleable body of the young progeny; but also indirectly by the environment’s affecting the sexual organs of the parents (*Foundations*, 1-2). Typically a breeder would examine variations in plant or animal offspring; and if any captured his fancy, he would breed only from those suitable varieties and prevent back-crosses to the general stock. Back-crosses, of course, would damp out any advantages the selected organisms might possess.

In the next section of the essays, Darwin inquired whether variation and selection could be found in nature. Variations in the wild, he thought, would occur much as they

did in domestic stocks. But the crucial, two-pronged issue was: "is there any means of selecting those offspring which vary in the same manner, crossing them and keeping their offspring separate and thus producing selected races" (*Foundations*, 5)? The first of these problems might be called the problem of selection, the second that of swamping out. In beginning to deal with these difficulties (and more to come), Darwin proposed to himself a certain model against which he would construct his device of natural selection. This model would control his language and the concepts deployed in the *Origin*. In the 1844 Essay, he described the model this way:

> Let us now suppose a Being with penetration sufficient to perceive the differences in the outer and innermost organization quite imperceptible to man, and with forethought extending over future centuries to watch with unerring care and select for any object the offspring of an organism produced under the foregoing circumstances; I can see no conceivable reason why he could not form a new race (or several were he to separate the stock of the original organism and work on several islands) adapted to new ends. As we assume his discrimination, and his forethought, and his steadiness of object, to be incomparably greater than those qualities in man, so we may suppose the beauty and complications of the adaptations of the new races and their differences from the original stock to be greater than in the domestic races produced by man's agency (Foundations, 85).

The model Darwin had chosen to explain to himself the process of selection in nature was that of a powerfully intelligent being, one that had foresight and selected animals to

produce beautiful and intricate structures. This prescient being made choices that were "infinitely wise compared to those of man" (*Foundations*, 21). As a wise breeder, this being would prevent back-crosses of his flocks. Nature, the analogue of this being, was thus conceived not as a machine but as a supremely intelligent force.

In the succeeding sections of both essays, Darwin began specifying the analogs for the model, that is, those features of nature that operated in a fashion comparable to the imaginary being. He stipulated, for instance, that variations in nature would be very slight and intermittent due to the actions of a slowly changing environment. But, looking to his model, he supposed that nature would compensate for very gradually appearing variations by acting in a way "far more rigid and scrutinizing" (*Foundations*, 9). He then brought to bear the Malthusian idea of geometrical increase of offspring, and the consequent struggle for existence that would cull all but those having the most beneficial traits.

Many difficulties in the theory of natural selection were yet unsolved in the essays. Darwin had not really dealt with the problem of swamping. Nor had he succeeded in working out how nature might select social, or altruistic, instincts, the ultimate goal of evolution. And as he considered the operations of natural selection, it seemed improbable that it could produce organs of great perfection, such as the vertebrate eye. His strategy for solving this last problem, however, did seem ready to hand—namely, to find a graduation of structures in various different species that might illustrate how organs like the eye might have evolved over long periods of time. Moreover, if natural

selection had virtually preternatural discernment, it could operate on exquisitely small variations to produce something as intricate as an eye.

Darwin's Big Species Book: Group Selection and the Morality of Nature

In September 1854, Darwin noted in his pocket diary, "Began sorting notes for Species theory." His friends had urged him not to delay in publishing his theory, lest someone else beat him to the goal. His diary records on May 14, 1856: "Began by Lyell's advice *writing* species sketch."[2] By the following fall, the sketch grew far beyond his initial intention. His expanding composition was to be called *Natural Selection,* though in his notes he referred to it affectionately as "my Big Species Book." And big it would have been: his efforts would have yielded a very large work, perhaps extending to two or three fat volumes. But the writing was interrupted when Lyell's prophesy about someone else forestalling him came true. In mid-June 1858, he received the famous letter from Wallace, then in Malaya, in which that naturalist included an essay that could have been purloined from Darwin's notebooks. After reassurances from friends that honor did not require him to toss his manuscript into the flames, Darwin compressed that part of the composition already completed and quickly wrote out the remaining chapters of what became the *Origin of Species.*

At the beginning of March 1858, a few months before he had received Wallace's letter, Darwin had finished a chapter in his manuscript entitled "Mental Powers and Instincts of Animals." In that chapter he solved a problem about which he had been worrying for almost a decade. In his study of the social insects—especially ants and

bees—he recognized that the workers formed different castes with peculiar anatomies and instincts. Yet the workers were sterile, and so natural selection could not act on the individuals to preserve in their offspring any useful habits. How then had these features of the social insects evolved? In a loose note, dated June 1848, in which he sketched out the problem, he remarked "I must get up this subject—it is the greatest *special* difficulty I have met with."[3]

Though Darwin had identified the problem many years before, it was only in the actual writing of his Big Species Book that he arrived at a solution. He took his cue from William Youatt's *Cattle: Their Breeds, Management, and Disease* (1834). When breeders wished to produce a herd with desirable characteristics, they would choose animals from several groups and slaughter them. If one or another had, say, desired marbling, they would breed from the family of the animal with that characteristic.[4] In the "Species Book," Darwin rendered the discovery this way:

> This principle of selection, namely not of the individual which cannot breed, but of the family which produced such individual, has I believe been followed by nature in regard to the neuters amongst social insects; the selected characters being attached exclusively not only to one sex, which is a circumstance of the commonest occurrences, but to a peculiar & sterile state of one sex (*Species Book*, 370).

Darwin thus came to understand that natural selection could operate not only on individuals but also on whole families, hives, or tribes. This insight and the expansion of his theory of natural selection would have two important dividends: first, he could

exclude a Lamarckian explanation of the wonderful instincts of the social insects—since no acquired habits could be passed to offspring—and simultaneously he could overcome a potentially fatal objection to his theory (see Lustig, this volume). But second, this theory of family selection (or community selection as he came to call it) would enable him to solve the like problem in human evolution, namely the origin of the altruistic instincts. In the *Descent of Man,* Darwin would mobilize the model of the social insects precisely to construct a theory of human moral behavior that contained a core of pure, unselfish altruism—that is, acts that benefited others at cost to self, something that could not occur under individual selection (Richards, 1987, 206-19). Hence, the final goal of evolution, as he originally conceived its telic purpose, could be realized: the production of the higher animals having moral sentiments. Yet not only did Darwin construe natural selection as producing moral creatures, he conceived of natural selection itself as a moral and intelligent agent.

The model of an intelligent and moral selector, which Darwin cultivated in the earlier essays, makes an appearance in the Big Species Book. In the chapter “On Natural Selection,” he contrasted man’s selection with nature’s. The human breeder did not allow “each being to struggle for life”; he rather protected animals “from all enemies.” Further, man judged animals only on surface characteristics and often picked countervailing traits. He also allowed crosses that reduced the power of selection. And finally, man acted selfishly, choosing only that property which “pleases or is useful to him.” Nature acted quite differently:

> She cares not for mere external appearances; she may be said to scrutinize with a severe eye, every nerve, vessel & muscle; every habit, instinct, shade of constitution,—the whole machinery of the organization. There will be here no caprice, no favouring: the good will be preserve & the bad rigidly destroyed (*Species Book*, 224).

Nature thus acted steadily, justly, and with divine discernment, separating the good from the bad. Nature, in this conception, was God's surrogate, which Darwin signaled by penciling in his manuscript above the quoted passage: "By nature, I mean the laws ordained by God to govern the Universe" (*Species Book*, 224; see also Brooke, this volume). As Darwin pared away the overgrowth of the Big Species Book, the intelligent and moral character of natural selection stood out even more boldly in the précis, that is, in the *Origin of Species*.

Natural Selection in the Origin of Species

In the first edition of the *Origin*, Darwin approached natural selection from two distinct perspectives, conveyed in two chapters whose titles suggest the distinction: "Struggle for Existence" and "Natural Selection" (chapters 3 and 4). Though their considerations overlap, the first focuses on the details of the operations of selection and the second contains the more highly personified re-conceptualization of its activities. In chapter 3, Darwin proposed that small variations in organisms would give some an advantage in the struggle for life. He then defined natural selection:

> Owing to this struggle for life, any variation, however slight and from whatever cause proceeding, if it be in any degree profitable to an individual of any species, . . . will tend to the preservation of that individual, and will generally be inherited by its offspring. The offspring, also, will thus have a better chance of surviving. . . I have called this principle, by which each slight variation, if useful, is preserved by the term Natural Selection (Origin, 61).

Darwin would explain what he meant by "struggle" a bit later in the chapter, and I will discuss that in a moment. Here, I would like to note several revealing features of his definition. First, selection is supposed to operate on all variations, even those produced by the inheritance of acquired characters and not just those that arise accidentally from the environment acting on the sex organs of parents. Second, Darwin believed that virtually all traits, useful or not, would be heritable—what he called the "strong principle of inheritance" (Origin, 5). Third, though the initial part of the definition indicates it is the individual that is preserved, in the second part it is the slight variation that is preserved—which latter is the meaning of the phrase "natural selection" (Origin, 61 and 81). The passage draws out "the chicken and egg" problem for Darwin: a trait gives an individual an advantage in its struggle, so that the individual is preserved, who, in turn, preserves the trait by passing it on to offspring. Finally, the definition looks to the future, when useful traits will be sifted out and the non-useful extinguished, along with their carriers. In the short run, individuals are preserved; in the long run, it is their morphologies that are both perpetuated and slowly change as the result of continued selection.

"We behold," Darwin observed (using a recurring metaphor), "the face of nature bright with gladness"; but we do not see the struggle that occurs beneath her beaming countenance (*Origin*, 62). But what does "struggle" mean and who are the antagonists in a struggle for existence? Darwin said he meant "struggle in a "large and metaphorical sense," which, as he spun out his meandering notion, would cover three or four distinct meanings (*Origin*, 62-63). First, an animal preyed upon will struggle with its aggressor. But as well, two canine animals will also "struggle with one another to get food and live." The image Darwin seems to have had in mind was that of two dogs struggling over a piece of meat. Furthermore, struggle can be used to characterize a plant at the edge of the desert: it struggles "for life against the drought." In addition, one can say that plants struggle with other plants of the same and different species for their seeds to occupy fertile ground. These different kinds of struggle, in Darwin's estimation, can be aligned according to a sliding scale of severity. Accordingly, the struggle will move from most to least intense: between individuals of the same variety of a species; between individuals of different varieties of the same species; between individuals of different species of the same genus; between species members of quite different types; and finally, between individuals and climate. These various and divergent meanings of struggle seem to have come from the two different sources for Darwin's concept: de Candolle, who proclaimed that all of nature was at war, and Malthus, who emphasized the population consequences of dearth. Today, we would say that struggle—granted its metaphorical sense—properly occurs only between members of the same species to leave progeny. Adopting de Candolle's emphasis on the warlike aspects of struggle may have led Darwin to distinguish natural selection

from sexual selection, which latter concerns not a death struggle for existence but males' struggling for matting opportunities.

In the chapter "Natural Selection" in the *Origin,* Darwin characterized his device in this way, pulling phrases from his earlier essays and Big Species Book but rendering them with a biblical inflexion:

> Man can act only on external and visible characters: nature cares nothing for appearances, except in so far as they may be useful to any being. She can act on every internal organ, on every shade of constitutional difference, on the whole machinery of life. Man selects only for his own good; Nature only for that of the being which she tends. . . Can we wonder, then, that nature's productions should be far "truer" in character than man's productions; that they should be infinitely better adapted to the most complex conditions of life, and should plainly bear the stamp of far higher workmanship? (Origin, 83-84).

The biblical coloring of Darwin's text is condign for a nature that is the divine surrogate and that acts only altruistically for the welfare of creatures. The attribution of benevolence to nature becomes explicit in Darwin's attempt to mitigate what might seem the harsh language of struggle. He concludes his chapter "Struggle for Existence" with the solace: "When we reflect on this struggle, we may console ourselves with the full belief, that the war of nature is not incessant, that no fear is felt, that death is generally prompt, and that the vigorous, the healthy, and the happy survive

and multiply" (Origin, 79). Darwin's model of moral agency mitigated the force of Malthusian pitilessness.

Conclusion

I have argued that Darwin did not come to his conception of natural selection in a flash that yielded a fully formed theory. What appears as the intuitive clarity of his device is, I believe, quite deceptive. I have tried to show that his notions about the parameters of natural selection, what it operates on and its mode of operation, gradually took shape in Darwin's mind, and hardly came to final form even with the publication of the first edition of the *Origin of Species.* In this gradual evolution of a concept—actually a set of concepts—I have emphasized the way Darwin characterized selection as a moral and intelligent agent. Most contemporary scholars have described Darwinian nature as mechanical, even a-moral in its ruthlessness. To be sure, when Wallace and others pointed out what seemed the misleading implications of the device, Darwin protested that, of course, he did not mean to argue that natural selection was actually an intelligent or moral agent. But even Darwin recognized, if dimly, that his original formulation of the device and the cognitively laden language of his writing carried certain consequences with which he did not wish to dispense—and, indeed, could not do so without altering his deeper conception of the character and goal of evolution. Darwin's language and metaphorical mode of thought gave his theory a meaning resistant to any mechanistic interpretation and unyielding even to his later, more cautious reflections.

Let me spell out some of those consequences to make clear how markedly Darwin's original notion of evolution by natural selection differs from what is usually attributed to him. Natural selection, in Darwin's view, moved very slowly and gradually, operating at a stately Lyellian pace (perhaps seizing on useful variations that might occur only after thousands of generations; *Origin*, 80 and 82). It compensated for meager variability by daily and hourly scrutinizing every individual, for even the slightest and most obscure variation, to select just those that gave the organism an advantage. A nineteenth-century machine could not be calibrated to operate on such small variations or on features that might escape human notice. If natural selection clanked along like a Manchester spinning loom, one would not have fine damask—only a skillful and intelligent hand could spin that—or the fabric of the eye.

Second, Darwin frequently remarked in the *Origin* that selection operated more efficiently on species with a large number of individuals in an extensive, open area (*Origin*, 41, 70, 102, 105, 125, 177, 179). He presumed that, as in the case of the human breeder, a large number of individual animals or plants would produce more favorable variations upon which selection might act. The greater quantities would also create Malthusian pressure. Yet in the wild, this scenario for selection could only occur if the watchful eye of an intelligent selector somehow gathered the favored varieties together and isolated them so as to prevent back-cross into the rest of the stock. When Fleeming Jenkin, in his review of the *Origin*, pointed out the problem of swamping of single variations, Darwin suggested in the fifth edition that groups of individuals would all vary in the same way due to the impact of the local environment (*Variorum,* 179). Thus when the implications of his model of intelligent nature were recognized, Darwin

had to invoke as analogue a Lamarckian scenario. Today, we assume that small breeding groups isolated by physical barriers would more likely furnish the requisite conditions for natural selection.

Third, a wise selector that has the good of creatures at heart would produce a progressive evolution, one that created ever more improved organization, which Darwin certainly thought to be the case. He believed that more recent creatures had accumulated progressive traits and would triumph over more ancient creatures regardless of the environments in which they might compete (*Origin,* 336-37). He summed up his view in the last section of the *Origin*: "And as natural selection works solely by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection" (*Origin*, 489). This passage, which remains unchanged through the several editions of the *Origin*, is an index of both Darwin's moral conception of nature and of its progressive intent. The moral overlay of the passage has blotted out the winnowing force of selection, which hardly works for the benefit of every creature. And, as Darwin made clear in the third edition, the "improvements" wrought by selection will "*inevitably* lead to the gradual advancement of the organization of the greater number of living beings throughout the world" (*Variorum,* 221; my emphasis).

Fourth, such an intelligent agency would not merely select for each creature's good, but also for that of the community. Darwin, in the fifth and sixth editions of the *Origin,* extended his model of family selection to one that operated simply on a community: "In social animals it [natural selection] will adapt the structure of each individual for the

benefit of the community; if this in consequence profits by the selected change" (*Variorum*, 172).

Finally, the intelligent and moral character of natural selection would produce the goal that Darwin had sighted early in his notebooks, namely the production of the higher animals with their moral sentiments. Darwin thus concluded his volume with the Miltonic and salvific vision that he harbored from his earliest days:

> Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed laws of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved (Origin, 490).

Darwin's vision of the process of natural selection was anything but mechanical and brutal. Nature, while it may have sacrificed a multitude of its creatures, did so for the higher "object," or purpose, of creating beings with a moral spine—out of death came life more abundant. We humans, Darwin believed, were the goal of evolution by natural selection.

Notes

[1] Single wedges indicate erasure, double indicate addition.

[2] Charles Darwin, *Personal Journal* MS 34, Cambridge University Library, DAR 158.1-76.

[3] Charles Darwin, Cambridge University Library DAR 73.1-4. I have discussed the problem of the social insects in Richards, 1987, 142-52.

[4] Charles Darwin, Cambridge University Library DAR 73.1-4.

Bibliography

Darwin, Erasmus. 1796. *Zoonomia or the Laws of Organic Life*. 2d ed. 2 vols. London: Johnson.

Huxley, Leonard. 1900. *Life and Letters of Thomas Henry Huxley*. 2 vols. New York: D. Appleton.

Lewontin, Richard. 1978. "Adaptation," *Scientific American,* 239: 220.

Lyell, Charles. 1987. *Principles of Geology*. 3 vols. Chicago: University of Chicago press.

Malthus, Thomas. 1826. *An Essay on the Principle of Population*. 6th ed. London, Murray.

Richards, Robert J. 1987. *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior.* Chicago: University of Chicago Press.

Richards, Robert J. 1992. *The Meaning of Evolution: The Morphological Construction and Ideological Reconstruction of Darwin's Theory*. Chicago: University of Chicago Press.

Sebright, John. 1809. *The Art of Improving the Breeds of Domestic Animals*. London: Howlett and Brimmer.

Wilkinson, John. 1820. *Remarks on the Improvement of Cattle, etc. in a Letter to Sir John Saunders Sebright*. 3rd ed. Nottingham.

Youatt, William. 1834. *Cattle: Their Breeds, Management, and Disease*. London: Library of Useful Knowledge.